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THE TREATMENT OF SHORTSIGHT

THE TREATMENT OF SHORTSIGHT

BY

PROFESSOR DR. J. HIRSCHBERG

GEH. MED. RAT IN BERLIN

TRANSLATED BY

G. LINDSAY JOHNSON, M.D., F.R.C.S.

WITH TWELVE ILLUSTRATIONS

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PREFACE BY THE TRANSLATOR

Last year Professor Hirschberg kindly presented me with a copy of his then recently delivered lecture on Shortsight. On reading it through I was so impressed with its value that I asked his permission to translate it into English. This he not only readily agreed to, but did all in his power to facilitate its publication. I have made as literal a translation as possible, but it has been found necessary in some instances to alter the sentences, which, although admirable in the German tongue, require to be recast to suit English readers. Still, even in these cases I have endeavoured to reflect the exact meaning he wished to convey.

The unique experience of Professor Hirschberg, extending over several decades of uninterrupted ophthalmic practice, together with his marvellous powers of observation, have rendered this treatise of especial value not only to the student, but also to the experienced oculist. I know of no work which covers the ground so exhaustively.

Seeing how large a proportion of the general public are fitted with glasses, both by the general practitioner and the vast body of opticians throughout the country, I believe this work will have a double value, not only by guiding them to correct myopia in a scientific manner, but, what is far more important, by pointing out the dangers and pitfalls which beset those who attempt to correct high degrees of myopia, without possessing that special knowledge which only a large experience of eye disease can obtain.

G. LINDSAY JOHNSON.

JOHANNESBURG, SOUTH AFRICA.

PREFACE BY THE AUTHOR

At the request of Professor v. Leyden I delivered a lecture on the treatment of shortsight which was published in his "German Clinic" at the commencement of the twentieth century.

Some of my colleagues who happened to peruse my article in this comprehensive essay (an article which although including the current literature, was nevertheless entirely based on my own experience) requested me to publish it separately, in order to make it more accessible to students of ophthalmology. This wish was rendered possible by the cooperation of my publishers.

I have therefore placed this essay before my colleagues in its original form, as any alteration would only interfere with its general design, since the additions to our knowledge during the last few years have confirmed rather than modified the fundamental propositions here set forth and based on my own experience.

J. HIRSCHBERG.

BERLIN, GERMANY.

THE TREATMENT OF SHORTSIGHT

GENTLEMEN: Before concluding my course of lectures you requested me once more to deal with the treatment of myopia in a more exact and detailed manner. I do this the more willingly since I am thoroughly convinced of the practical importance of this subject.

The scientific conception of myopia is almost as old as scientific medicine itself. It can be traced in the ophthalmological Canon of the ancient Greeks.[1]

"Shortsight is that condition in which near objects are clearly defined but not distant ones." The Greeks, from the standpoint of comparative anatomy, even distinguished farsighted from nearsighted animals.[2]

We can commence here, by separating those animals which belong to the shortsighted type from the other group which deviates from the normal in the pathological sense of the word.

To the first group belong not only the multiple facetted eyes of insects and crustacea which, by means of careful investigations have been shown to form sharp images of ex-

[1] *Galen*, VII, 98; XIV, 776; XIX, 436; *Oribas.*, V, 457; *Paul. Æg.*, III, c. 22, § 42; *Æt.*, VII, c. 47; *Akt.*, II, 449. (See also my Dictionary of Ophthalmology, p. 60, and my History of Ophthalmology Among the Ancients, § 58 and § 246.) In most of these references myopia is treated as congenital.

[2] *Aristotle*, The Begetting of Animals, V, c. 1. History of Comparative Ophthalmology, § 58.

tremely near objects,[1] but also the dioptric eyes of fishes and frogs.[2] A fish's eye in water is myopic; moreover farsight would be useless to it, since at no great depth the clearest water is impenetrable to light. The frog does not stare at Sirius, but snaps at flies which venture within its range.

The birds and large mammals[3] belong to the second group, viz., that of the farsighted animals, the first mentioned being very sharpsighted while the latter are less so to a considerable degree. Whenever on examining a horse's eye by means of the ophthalmoscope, I discovered a marked degree of myopia, a diseased alteration of the eyeball was invariably found to be the cause—in most cases the commencement of senile cataract.

For the human being we require, in a practical sense, what Ovid expressed poetically, viz., "Os homini sublime dedit cœlumque tueri jussit."

The normal human eye requires to see to the remotest distances, while at the same time it must be adaptable to near objects. In fact if one selects either small or large groups from people living in a natural, i.e., an uncivilized state,[4] and takes pains to exclude those suffering from a

[1] *J. Nothaft,* Senkenberg's Naturforscher Gesellschaft, XII, Frankfort a. M., 1880. Vergl. Centralbl. f. Augenheilk., 1880, p. 365.

[2] *J. Hirschberg,* Zur Dioptrik der Fisch-u. Amphibien-Augen. Archiv f. Physiologie, 1882. Cf. my Einführung, I, p. 111.

[3] *J. Hirschberg,* Zur vergleichenden Ophthalmoskopie, Arch. f. Physiol., 1882.

[4] *Furnari,* Annal. d'Oculist, X, p. 148; *Cohn,* Centralbl. f. Augenheilk., III, p. 199 (Nubier); *Reich,* p. 302 (Georgier); *Kotelmann,* Berliner klin. Wochensch., 1879; Centralbl. f. Augenheilk., 1880, p. 63. *Webster-Fox,* Ibid., IV, p. 189 (Indianer); *Seggel,* Arch. f. Anthrop., XIV, p. 3; *Nagel's* Jahresbericht, XIV, p. 69 (Feuerländer, Indianer); *Kotelmann,* Berliner klin. Wochensch., 1884, No. 25, and Zeitsch. f. Ethnographie, 1884, p. 74; *Cohn,* Berliner klin. Woch., 1898, No. 20, Central. f. Augenh., 1898, p. 351; *Abelsdorff,* ditto, p. 395; *Bietti,* ditto, p. 554.

diminution of acuity—whether from an injury or a diseased condition of the eye—one will not find among them a single case of myopia. If we investigate ophthalmoscopically a large group of new-born infants[1] or of very young children, among our own race we shall find scarcely a single case of myopia. On the other hand every one is aware of the fact that among older children and adults of cultured races a very considerable proportion of myopes are to be found.

Historians tell us that in the scientific literature dating from Aristotle's works[2] to our own time, shortsighted individuals are mentioned. Physicians are familiar with the fact that in some cases the myopia remains unaltered as age advances, in others it increases to a moderate degree, until the individual has ceased growing, while in a small but definite proportion of cases, the myopia progresses to the highest degree along with increasing failure of sight.

In the year 1867, *Hermann Cohn*,[3] of Breslau, in his laborious investigations on the sight of 10,000 school children showed that in the elementary schools myopia was present in 1.4% of the children. In the intermediate schools, 10%, while in the high schools (Gymnasia) as many as 26% of the scholars were shortsighted. The same writer in his "Hy-

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[1] *Königstein, Ulrich, Schleich* and *Herrnheiser* found no cases of myopia among 3,200 eyes of newly born children. *Herrnheiser* only met with one solitary case among 1,920 newly born children examined by the direct method under atropin. He examined 54.6 eyes of children between the first and sixth year and found 4% myopic, 24% emmetropic, and 72% hyperopic. (See *Herrnheiser*, Die Refractions-Entwicklung of the Human Eye, Zeitsch. f. Augenheilk., 1892, and as a separate publication, Berlin, 1893; Centralb. f. Augenheilk., 1892, p. 288. See, also, the latest publication on this subject by *Elschnig*, Zeitsch. f. Augenheilk., 1904, XI, p. 1.

[2] Geschichte der Augenheilkunde im Alterthum, § 58.

[3] Untersuchung. der Augen von 10,000 Schulkindern, Leipsig, 1867.

giene of the Eyes"[1] sums up the collective results obtained from 200,000 school children, which agree in all essential points with the above-mentioned figures.

Tscherning[2] made a special study of the vision of adults, and particularly of artisans between the ages of eighteen to twenty-five, the average being twenty-two years. These were selected from Copenhagen, and the country people of every position and calling in life. Out of 7,573 men thus examined he found the following proportion of myopics: university students, 32%; clerks, 16%; artisans, 5%; peasants, 2%.

The influence which working at close distances has on the production of myopia is obvious. But the highest degree of shortsight (i.e., above 9 D, i.e., dioptries) obeys other laws, since it is commoner among the lower orders, or at least is equally distributed among all classes; moreover it is only in this variety of myopia that we meet with specially dangerous complications.

At any rate one cannot prove offhand that myopia is a consequence of study, and that the tendency toward shortsight can be propagated by inheritance.

From a Darwinian point of view, myopia has been expressed as a harmless, perhaps even a useful adaptation of the human eye to a continually increasing degree of culture.[3]

But this cannot be so readily admitted even when we disregard all hypotheses, and keep entirely to the actual conditions before us. If we admit, and I myself willingly do so, that the lower grades of myopia form rather a desirable ac-

[1] Wien und Leipsig, 1892.

[2] Arch. f. Ophth., 1883, XXIX, 1, 201–272.

[3] To many people this is an article of faith. I do not hold this view.

quisition than otherwise for the cultured classes[1] (by cultured classes I mean not only the highly educated but all who continually apply themselves to fine or minute work)—since it facilitates the more general adaptability of the eyes to near objects, while at the same time one has at one's disposal the optical assistance of concave glasses for the less required distant vision—we have still always two facts to consider: on the one hand that shortsight is a deviation from the normal type, and on the other hand that a high degree of myopia is almost invariably accompanied by a diminution of visual acuity, which by reason of the diseases that follow in its train tends to great impairment, or even total loss of vision.

The proportion of cases in which life is rendered miserable by the disastrous sequelæ of high myopia leading to partial or total blindness, amounting, even in my own practice, to several thousands, is too great to afford the impartial observer any satisfaction by thus trifling with the Darwinian hypothesis. We must admit with *Donders*[2] that progressive myopia is a veritable disease.

The surgeon feels himself obliged to lend a helping hand. We find ourselves in fact in the field of therapeutics of the highest importance, such as we find in the operation for cataract, where, within a minute, we convert a blind eye into a seeing one, and complete the cure within a few days.

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[1] This has given rise to the old idea of the laity that myopic eyes are especially strongsighted, since in a weak light they can still perceive minute details and can read without convex glasses even in old age. But it is purely a popular fallacy.

[2] This was in 1866. In 1881 he changed his opinion. See his classical work, Die Anomalien der Refraction u. der Accommodation, Vienna, 1866, and also the 22 jähr. Jahresbericht des Neederl. Gasthuis f. Ooglijders, 1881.

This field has been only recently conquered, by the labors of the last century and especially during the last ten years. The knowledge of the cause of myopia has afforded us a means at hand of preventing or at any rate of improving and compensating the condition.

I have already in my opening remarks quoted the first and quite accurate proposition which occurs in the Grecian canon on Shortsight, and I now give the second one which follows on: "Such a condition is incurable, since it arises from a weakness of the spirit of vision" (Sehgeist). The Greeks implied that when too little spirit of vision was poured out from the brain to the pupil of the eye it was too feeble to extend to distant objects. This fanciful idea lasted for centuries. Even the Arabians were unable to shake themselves entirely free from it, although their physicists and philosophers (*Ibn el Haitam* and *Ibn Roschd*) proved that during the act of vision light entered the eye and was there refracted, and that nothing streamed out from the eye itself.

Johannes Kepler[1] was the first to correctly define the science of refraction by means of convex and concave glasses as well as by the eye, and especially as regards

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[1] In that wonderful work, Ad Vitellionem Paralipomena quibus astronomiæ pars optica traditur, Francofurti ap. Claud. Marin. et hered. J. Aubrii, 1604, p. 296. Cf. *Joannis Kepleri* Op. omnia ed. Dr. *Ch. Frisch*, Francofurti et Erlangæ, 1899, II. Cf. also *Joannis Kepleri* dioptrice Augustæ Vindelic., 1611. *Vopiscus Fortunatus Plempius*, physician in Amsterdam (1633–1671, professor at Louvain), himself somewhat shortsighted, assiduously studied the cause of his visual defect and gladly accepted *Kepler's* theory (cf. his Ophthalmographia, Amsterdam, 1632, p. 250). *Hermann Boerhaave* in 1788 appears to have expounded the subject in his lectures on diseases of the eye. (*H. Boerhaave*, prælect. p. de morb. ocul. ex c. m. s. ed. Gottingæ, 1746, p. 168. German translation by *Claude*, Nürnberg, 1751, p. 248.

myopia, so that little by little the surgeons of the time began to place their confidence in this interpretation. Our forefathers had already observed the anatomical causes of the apparently excessive refraction of the myopic eye without being able to explain it,[1] and they had observed it in a few cases in actual life, but it was not until 1854 that Ferdinand Arlt[2] produced the anatomical proof that high typical myopia was due to an elongation of the visual axis of the globe, and that as the shortsight progressed so the axis became lengthened.[3]

In order to understand the subject better, we must first consider the normal emmetropic[4] eye. In the average emmetropic European eye the cornea in the neighborhood of the visual axis (i.e., at the pole) has a curvature of 7.7 mm. radius, and is therefore capable of bringing a parallel bundle of rays falling on it, to a focus about 30 mm.[5] behind its front surface, i.e., to a point about 6 mm. behind the retina, on the assumption that the normal adult eye has a length of 24 mm. (See Fig. 1, *A*.)

Now the crystalline lens when relaxed, as it is then adjusted for distant vision, possesses a focal distance of 60 mm. By its help the rays already convergent after passing through

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[1] See the Ophthalmology of *Ætius* of Amida in the sixth century after Christ. Edited by *J. Hirschberg*, Leipsig, 1899, p. 144.

[2] Prager Monatschrift, June, 1854.

[3] See my Introduction to Ophthalmology (Einführung in die Augenheilkunde, 1892, I, p. 84).

[4] ἐμ-μετρος, full measure; ὠψ, vision.

[5] The general dioptric equation is $F_2 = \frac{n_2 R}{n_2 - n_1}$ where F_2 = posterior focal point. n_1 = index of refraction for air, n_2 = index for cornea and humours. R = radius of the cornea, holds good for rays passing from air through the cornea and aqueous which, expressed by figures, $F_2 = \frac{\frac{4}{3} R}{\frac{4}{3} - 1} = 4 R$ = 30.8 mm. (See *Hirschberg's* Introduction to Ophthalmology, I, p. 176.)

the cornea become still more convergent, so that they unite on the retina to form a sharp image focus (Fig. 1, *B*).

When the parallel bundle of rays which fall on the cornea come to a focus on the retina the refractive condition is that of emmetropia. If the focus lies in front of the retina it constitutes shortsight, or myopia.[1] If it lies behind the retina it constitutes longsight—or hyperopia.[2]

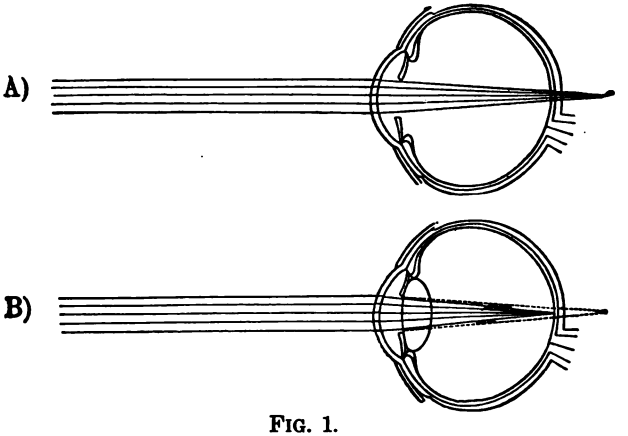

FIG. 1.

Hence a bundle of rays which proceed from a very distant point and therefore practically parallel, become refracted by the double refractive system of the eye (in fact a double objective, viz., cornea + lens), and meet at the principal focus. In the case of myopia this focus lies in front of the eye, from whence the rays spread out and form a diffusion circle $N_1 N_2$ on the retina (Fig. 2).

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[1] Μύωψ, from μύω, I close; ὤψ, the eye. This occurs already in Aristotle's erroneous work, Problemata (Ausgabe der Berliner Akademie, 1831, II, pp. 958, 959).

[2] I have throughout this work used the term hyperopia in preference to the longer one hypermetropia, but both words are identical in meaning.—*Translator.*]

The image of a distant object appears to the myopic eye hazy and confused. Instead of a sharp image, every point on the object gives rise to a circle of confusion on the retina. The circles of adjacent points overlap one another, hence the

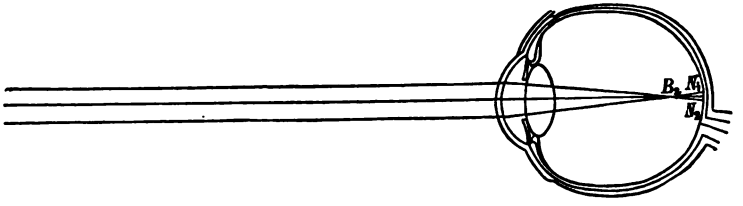

FIG. 2.

image of distant objects appear ill-defined and often unrecognizable. The crescent of the moon appears as a large multipointed light patch.[1] It is obvious that this circle of confusion must increase as distance of the retina becomes more and more removed from the posterior principal plane.

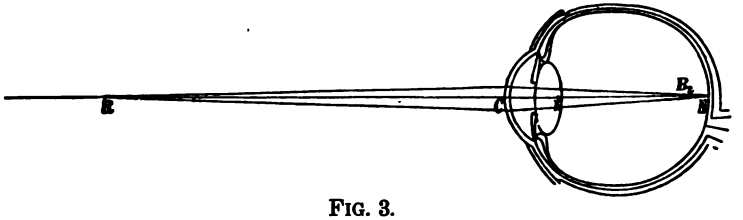

FIG. 3.

If, however, a bundle of rays proceeds from a point at a given finite distance from the myopic eye, and which therefore enters the cornea of the eye as a divergent bundle, the point may be so placed that the double objective (i.e., the

[1 To most myopes of medium degree, the crescent moon appears not as a multipointed light patch, but as a rosette consisting of a series of fairly well-defined crescents, which overlap and are arranged round a common centre. But the description given in the text is quite accurate in a general sense.—*Translator.*]

cornea and lens) brings the rays to an exact focus on the retina. See Fig. 3. Here R = most distant point of an object which can form a sharp image on the retina B_2; R is therefore the far point of this myopic eye.

Myopia must therefore occur in an eye when the retina lies behind the principal plane of its refracting system.

As a rule myopia, especially of the higher degrees, is due to an actual lengthening of the visual axis of the globe; in a word, the shortsighted eye is built too long as compared with the emmetropic eye, while the refractive system in a passive state does not materially differ in the two eyes.

This, which is the typical condition, is known as axial myopia, to distinguish it from the rarer form of curvature myopia,[1] whereby the relatively excessive refraction of the myopic eye is produced by excessive curvature, especially of the cornea.

Mixed myopia is a condition where the excessive refraction is partly due to axial elongation and partly to increased curvature of the refracting media.

While myopia, said to be produced by increased refractive index of the aqueous (as in certain forms of choroiditis), is merely a false assumption, alterations of the crystalline lens are certainly the cause of definite forms of pathological shortsight. Old people, who up till recently have enjoyed excellent distance sight, and have constantly used the proper convex glasses for reading, now place them on one side and use concave glasses for the first time for distant vision. These soon require to be increased in power, even to as much

[1] One must not confuse myopia with the conical (hyperbolic) curvature of the cornea. To the inexperienced the commencement of conical cornea (keratoconus) appears as a myopic eye combined with weak sight. Fortunately this is a rare disease. Many cases of slight laminar cataract may be mistaken for a myopic eye.

as −6 D, while perhaps with −3 D they already display a certain amount of reduced acuity. On examination the surgeon finds commencing opacity of the crystalline (senile cataract). Should the opacity increase, an operation for cataract may be performed, and later on the eye will be adapted for distant vision by means of the same convex glasses which are required for an emmetropic eye which has been operated on in the same way; a proof that this form of myopia is due to the condition of the crystalline. The actual cause is the increase in the refractive index of the lens nucleus. I have seen many cases of the same nature, and have pointed out this form of shortsight for a great many years.[1]

Allied to this is the *diabetic shortsight.*[2] It is a rare condition it is true, but an important one, especially as it permits of a treatment based on the cause. The general practitioner should bear in mind that diabetic myopia in adult life and old age develops quite suddenly, whereas the ordinary form of shortsight develops very gradually during youth. Suitable diet and internal remedies can effectually reduce this kind of myopia. The congenital conical curvature (lenticonus anterior) of the pupillary part of the anterior surface of the lens, or even of the posterior surface, which is a rare cause of myopia, can only be corrected by glasses in a few exceptional cases, and deserves merely a passing notice.

Congenital displacement of the lens (ectopia lentis) as well as a lens tilted or displaced through an injury (subluxatio lentis) which by being freed from the natural lateral

[1] Beitr. zur practischen Augenheilkunde, 1878, III, p. 90.

[2] I made observations on this condition as far back as 1878, and described it in the Deutsche med. Wochenschr. for 1887, Nos. 17 to 19, and again in the Centralblatt f. prakt. Augenh. for 1890, p. 7, and Deutsche med. Wochenschr. 1891, No. 13.

compression of the suspensory ligament on the capsule, becomes immediately more strongly curved and thus induces shortsight.[1]

But all these varieties are rare in comparison with the typical form of shortsight.

A simple illustration of typical myopia, which is the variety we have chiefly to consider, is afforded by the photographic camera when it is extended until the focussing screen lies outside the principal focus of the lens. In such a case it cannot give a sharp image of a distant object on the horizon, but can do so readily for a near object situated in the conjugate plane. The first measurement for myopia is the distance of the far point from the nodal point of the myopic eye at rest—in other words, the linear distance RK = R (Fig. 3). In reality, we only need to measure RC, since CK only amounts to about 7 mm. An eye whose far-point distance measured 2 inches = 5 cm. would correspond to a myopia of 2 inches = 20 D. If, on the other hand, R = 80″, i.e., 200 cm., the myopia would be equal to 80″, i.e., about 0.5 D.[2] In this way we have a practical means of estimating the degree of shortsight. Should the far point lie beyond 80″ = 200 cm., the eye as measured by the sight tests of the oculist might for most occupations in life be considered as emmetropic. Emmetropia, therefore, lies at the boundary of myopia.

A myopia ranging between 80 inches (200 cm. or 0.5 D) and 12″ (30 cm. or 3.25 D) is termed *low myopia.*

A myopia between 12 inches (30 cm. or 3.25 D) and 6

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[1] In other words, the front surface of the lens being released from the circumferential tension bulges forward, exactly as occurs during the act of accommodation.—*Translator.*

[2] 0. 5 Diopter = 80 inches; 1 D = 40 inches; 2 D = 20 inches; 5 D = 8 inches; 10 D = 4 inches, etc.

inches (15 cm. or 6 D) is termed *medium myopia*, while one between 6 inches (6 D) and 2 in. (5 cm. or 20 D) or even more, is termed *high myopia*. Fortunately, the higher grades of myopia are much rarer than the lower ones, although for the philanthropic surgeon they are still too many.

Donders[1] found 1,000 cases of myopia were made up as follows:

1. Low myopia, i.e., up to 3 D..... 525 cases
2. Medium myopia, i.e., 3 D to 6 D..... 250 "
3. High myopia, i.e., 6 D to 15 D..... 171 "
4. Very high myopia, i.e., from 15 to 30 D..... 54 "

I myself have collected statistics of 560 cases of high myopia (6 D and over) which came to my clinic during 1901 and 1902, out of a total of 12,328 new patients and which were examined by my assistant *Dr. Rosenstein*. They comprised:

Myopia of 6 D—10 D		11 D—20 D		21 D—35 D	
Males	140	Males	84	Males	10
Females	166	Females	149	Females	11
Total	306	Total	233	Total	21

With the exception of the very high degrees of myopia the women far outclass the men.[2]

It is remarkable that during the first ten years of life, 20 boys and 13 girls (or 33 cases in all of myopia of 6 D and over) were registered.

The second or practical measure of myopia is afforded by

[1] Refraction and Accommodation, p. 285.

[2] In my private consultations the men exceed the women—a point which we shall consider later.

the correcting spherical, i.e., the spectacle glass which neutralizes the myopia, or in other words brings the eye to a state of emmetropia (Fig. 4).

If a myopia is found of 20 inches focus (50 cm. or 2 D) when the eye is in a state of rest (i.e., with a relaxed accommodation or flattened crystalline), it requires an object to be placed at 20 inches distance R (RK=20″) in order to get a sharp image. The bundle of rays proceeding from the point R will be brought to a point image at N on the retina by means of the double objective of this myopic eye. If, on the

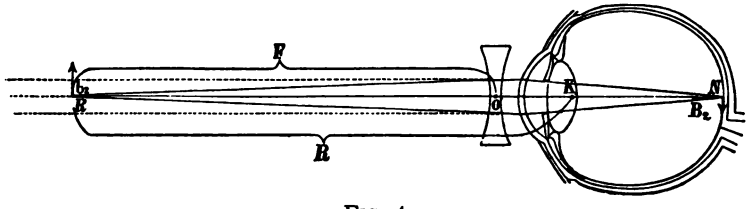

FIG. 4.

other hand, a parallel bundle of rays fall on the eye from a very distant object point (represented in Fig. 4 by dotted lines) the rays must be rendered so divergent that they will be refracted through the double objective to form an image point on the retina. This is effected by rendering the parallel bundle of rays divergent by means of a suitable concave (dispersing) lens placed in front of the cornea, which produces the needful divergence. That glass is suitable in which the second principal focus (B_2) corresponds to the far point of the eye (R.).

In the previous case a glass of approximately 20 inches or 50 cm. focal distance, i.e., a glass of 2 D, will be indicated. Such a case is said to represent a myopia of 2 D. In the case of strong glasses the difference between KR (far point)

and OR (focal distance of the glass) must be taken into consideration.

If O be removed a trifle farther from the eye and between the two an ophthalmoscope be placed having the mirror turned toward the patient's eye, then that concave glass which is found during the observation to convert the convergent rays reflected from the patient's fundus into a parallel bundle will represent the degree of myopia present. This objective test by means of the ophthalmoscope, to which sciascopy (retinoscopy) belongs, is an essential requisite in order to avoid errors in difficult cases.

The beginner who has attentively followed this argument might cry out with enthusiasm "I have it!" If one cannot convert an oval myopic eye anatomically into a spherical emmetropic one, one may at least be able to correct the myopia by physiological means. One has only to find the exact degree of myopia by means of objective and subjective tests in each individual case and the unfortunate consequences of myopia will be banished from the world.

As a matter of fact this naïve suggestion is of modern origin. At the present day there are many surgeons who call themselves oculists, and prescribe correcting glasses on this assumption. But many of these maltreated patients, suffering from very high myopia, escape from these oculists' prescriptions, by simply throwing away the glasses ordered for them, after a short time, owing to the pain and discomfort they cause, or else they consult other surgeons who act on more rational lines.[1] The problem is by no means so simple as the case of a man whose right leg happens to

[1] Oculists who are affected with a high degree of myopia, as was the case with the deeply lamented Professor *Mauthner*, of Vienna, have learnt by their own sensation the impossibility of wearing the full correction.

be two inches shorter than its fellow limb, which we treat by merely placing a sole of this thickness under his shoe.

I will explain my meaning by one or two cases in point.

About fifteen years ago a girl of ten years was brought to me from the country, who was wearing concave glasses of 10 D made according to an oculist's prescription. She suffered from such persistent headaches that she was reduced to the condition of a chronic invalid. I forbade her to wear the glasses at all and merely regulated her near work. The girl was restored to health at once. The amount of myopia did not increase. She goes about to-day without any glasses, and occasionally makes use of a pair of 9 D lorgnettes which she holds up in front of her eyes to see distant objects.

A man, sixty years of age, came to me from a South German town and informed me that for more than thirty years he had continued to wear concave glasses of 6.5 D. It is true they did not give a clear distant image, but sufficed for his purpose and did not cause him any inconvenience, until a new ophthalmic surgeon established himself in the town and persuaded him to exchange them for a much stronger pair of 10 D. From that time he did not have a moment's peace, until at length, after some months, he threw the glasses away and returned to his former pair, and from that date all his trouble vanished. Of course, I advised him to stick to his weaker glasses. The ophthalmoscope showed marked changes in the fundus.

The above cases are by no means exceptional. In my private practice I have had hundreds of similar cases[1] who

[1] *C. Hess*, in his admirable work on Refraction and Accommodation (p. 327, 1902), says that it is difficult to show clinical cases in which an injurious influence, due to full correction, is definitely proved. But he only speaks of low and medium grades of myopia.

have come to me from far and near, and were quite contented to lay aside their glasses of − 13 D or − 18 D. They should be impressively warned against this universal full correction. The oldest sophism of medicine,[1] viz., that the only gauge was the compatibility of the individual, has been fully substantiated by the ripe experience of the present-day practitioner.

On the whole the choice of the right spectacles for myopic persons is by no means a simple affair. We cannot leave it entirely to the opticians. The majority of them are reasonable enough to understand this. In some of the States in America—if I am not mistaken—a law has been passed that spectacles, like poisonous drugs, may only be sold on a surgeon's prescription. This perhaps is carrying matters too far. As regards the general practitioners in the country and small towns who are obliged in many cases to select the glasses themselves, *I would recommend the greatest caution, especially in prescribing high concave glasses.*

In the first place the amount of myopia, especially in young subjects, can easily be overestimated. The exact objective measurement by means of the ophthalmoscope, which is the best method to begin the examination with, ought to entirely prevent this error. In the same way the determination of the astigmatism can be made at the same time by this means.

By means of *Javal's* ophthalmometer[2] the permanent corneal astigmatism is on an average greater in myopics than in emmetropes, and when in the former cases it is greater,

[1] *Hippocrates*, Collection of Ancient Medicine, 9. This passage has been largely misunderstood.

[2] I willingly admit that the manipulation of this instrument is not to be expected of every general practitioner, but only of those who make ophthalmology a specialty.

and a not inconsiderable amount (say 2 D) of the opposite kind of astigmatism of the lens is compensated for, there is often a sufficient amount of astigmatism left over (especially in children and young persons who possess a still greater accommodative action) which masks the defect and shows itself as an apparent spasm of accommodation. A careful and correct determination will reveal no trace of accommodative spasm.[1] It is only exceptionally that it is found necessary to paralyze the accommodation muscle by means of a 1% solution of homatropin[2] in order to make a more exact diagnosis, and only very rarely is it required to drop into the eye a ½ to 1% solution of atropin for several days in succession in order to establish the kind and degree of accompanying astigmatism with precision. The correction of astigmatism for working glasses is especially important. In those children who in addition to a moderate degree of myopia, possess a considerable degree of astigmatism, a marked increase of myopia will be engendered during the school hours.

We will assume that the degree of myopia has been exactly ascertained for each eye separately, and also combined for the purpose of binocular vision. In the latter case one may often observe a slight diminution of the amount of correction compared with that required for the single eye.

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[1] I myself wrote in 1884: "I can scarcely bring myself to believe in the acute and not at all in the chronic form of accommodation spasm. Among the thousands of patients whom I have examined by the direct ophthalmoscopic method, and tested with glasses, I have never met with a single case." *C. Hess* wrote in 1903 (a. a. O., p. 265): "During my investigation of more than 5,000 school children I have not seen a single case of spasm of accommodation."

[2] Homatropin hydrobrom., 0.025.
Boiled distilled water, 2.5.

[3] Atrop. sulph. neutr., 0.05.
Aqua destil., 5.0.

As a rule the myopia is the same or nearly the same in both eyes, but by no means always. Often the correction of the weaker sight suffices for the second eye. Sometimes an increased sharpness afforded by the glass for the second eye improves the visual acuity in a marked manner. Occasionally, especially in double external squint, the difference in the refraction of the two eyes (the so-called refraction difference) must be completely eliminated, and particularly in the near glasses, so as to enable the patient to work with comfort.

If, therefore, the amount of myopia is determined with sufficient accuracy, and at the same time no important complications are present (about which I shall have to speak later on) the following rules as to the selection of glasses which are founded on the observation and treatment of very many thousands of myopes may be taken as a guide:

1. In low grades of myopia (between 0.75 and 3 D), one may allow the full correction to be continually used. To what extent one may prescribe glasses, especially in the case of youths, scholars of the lower and middle schools, apprentices, etc., in order to arrest the progress of the myopia I shall deal with more exactly later on, when I have to speak of the prevention of myopia and its disastrous consequences. That elderly men on the wrong side of fifty or sixty years of age should either remove their glasses, or at least proportionately reduce their strength, naturally follows, in consequence of the loss of power of accommodation which accompanies age, in other words of the consequent presbyopia, and the majority of mankind instinctively discover it for themselves. Those, however, who have been accustomed from their youth up to wear glasses uninterruptedly, must have positive directions given them, so that as age creeps on they may be

immediately and completely relieved of all unnecessary causes of complaint by having the glasses altered from time to time for near work.

2. In medium degrees of myopia (from 3.5 to 6 D) entirely or nearly corrected glasses are only to be used for distance purposes, while for near work weak glasses or none at all should be given. Occasionally *Franklin's* or other bifocal glasses may be prescribed.

3. In the higher grades of myopia (6 D and upward) two separate pairs of glasses should invariably be given. One pair for distance, and another weaker pair for near work. The last should possess about half the power of the former, or a little over.[1]

Glasses of greater power than −6 D, −8 or −9 D, should not, generally speaking, be worn continuously. Should the patient require distance glasses for special purposes at any time when he cannot perceive objects with −6 or 8 D, one may order him for this purpose and for a short time only a pair of pince-nez of − 2 D, −3 D, or even −5 D, according to the amount and requirements of his myopia, to place in front of his ordinary glasses. Still better are the so-called "frontage glasses," i.e., a pair of spectacles provided with clips, but without any sidearms.

High myopes who for general purposes cannot wear any glass and then only momentarily in times of need, may be provided with a lorgnette which may have the full

[1 I myself have a myopia of −6 D, and I find after having tried a large number of glasses of different powers that the greatest comfort is obtained by wearing a pair of spectacles of −3.5 D for all purposes, merely exchanging them for a pair of −6 D glasses when I wish to see objects at a distance with sharp definition, or at dusk or night-time out of doors when visual acuity is reduced, owing to the increased size of the pupils.—*Translator.*]

correction (10 D or even 12 D). But nobody can endure wearing −16, 18, or 20 D continuously. They make objects look too small and tire the eye.[1] Even those who have worn such glasses for a long time, are usually quite contented with weaker ones. In cases of such high degrees of myopia, for the sake of preserving their sight, it is in their own interests to dispense with sharp vision. In order to improve their distant vision they can use an opera-glass of low magnification, or a portable *Steinheil's* cone[2] for brief periods either before the naked eye or in front of their weak spectacles.

The selection of the proper glasses and the directions for their proper use are the first requisites for the treatment of ordinary myopia. This form of short sight is a deviation from the normal, a fault in the construction of the eye, although it does not exactly amount to a disease. To constitute a disease we must have the addition of disturbing changes in the eye which not unfrequently constitute a source of danger.

Should the reader raise the objection that the highest grades of shortsight (10 D and upward) already indicate a disturbing change, in so far as in the lowest grade (under 2 D) normal acuity is present, while in myopia of 10 D the acuity is reduced to a half, and finally in myopia of 20 D only a fifth of

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[1 The reader must not imagine by this that the image is *really* smaller, for if the eye is corrected for distant vision, the object is invariably the same size, whether the patient is myopic, emmetropic, or hyperopic, provided always that the correcting lens be placed exactly at the anterior focus of the eye. Objects do, however, appear a great deal smaller to a myope when he puts on glasses which completely correct the ametropia, owing to the fact that all diffusion circles are thereby removed by the m.—*Translator.*]

[2] This is a small solid cone of glass having an anterior convex and a posterior concave worked surface, which is more portable and handy than the old one-tube opera-glass which was employed for this purpose.

the normal acuity is present,[1] this only proves that the highest grades of shortsight of necessity effect these injurious changes in the globe, since a simple alteration in the refraction cannot produce any falling off of acuity.

I may here point out that the definition of what constitutes disease is included in the above sentences. We must make this clear. Two opposing views arise before us, one critic maintains that the myopic eye is a diseased one, the other disputes this; but neither of them deems it necessary to declare what is meant by disease, hence there is no agreement.

The ancients[2] defined disease as an unnatural condition, by which the activity of the organism becomes damaged. Among the modern school, *R. Virchow*[3] declared disease to be a lowering or weakening of the organism and the character of the danger rendered prominent, which gives its peculiar stamp to the morbid conditions. We will adhere to and accentuate this, that disease is a purely definite (concrete) conception, and not identical with a deviation from the ideal normal.

We have now to consider the complications of myopia and with the requisite exactness which in the ordinary text-books, and even in the special monographs are by no means systematically adhered to. Above all we have to add the practical treatment wherever it seems advisable. Before doing so I may make the following remark: In the high grades of myopia the alterations seen in the interior of

[1] See the investigations of *Leininger* on 2,893 myopic eyes, those of *Schleich* on 738 cases, by *Hess* loco citato, p. 320.

[2] *Galen* on the Differentiation of Symptoms, Chap. I, VII, p. 43. Also *Boerhaave*, Aphorismi, 1745, No. 1.

[3] *Virchow*, Handbuch der Path. u. Therapie, I, Erlangen, 1854, pp. 6 and 11.

the eye with the ophthalmoscope are so common that it is quite the exception not to see any change in a person over forty years of age who possesses a myopia of 6 D and over.

Horner found 34% of severe complications in 1,878 myopes which he examined between 1880 and 1883, and which consisted of: vitreous opacities, 9%; choroidal changes, 11%; detachment of the retina, 3½%; and grey cataract, 23%.[1] The average age of these cases with severe complications amounted to fifty years.

J. Stilling does not accept these statistics as being truly representative, because *Horner*, by his extensive practice, came in contact with all the severe cases throughout a large district. But even if they do not represent the true percentage among the general public, they still comprise the cases which he found in his consulting-room.

Perhaps it is not out of place to supplement *Horner's* private statistics by my own, which have come to my Poliklinik, for the most part patients from the surrounding district consisted solely of cases of 6 D and over. In the two years, 1901 and 1902, out of 12,328 new patients there were 560 cases of high myopia (6 D and over). Of severe complications were noticed:

Myopic chorio-retinitis	99
Vitreous opacities	43
Detachment of the retina	23
Hemorrhage of the retina and vitreous	7
Rise of tension	4
Cataract	18
Total	194

[1] From the above it will be seen that the total separate diseases exceed 34% (9 + 11 + 3½ + 23 = 46½). It is therefore probable that in several cases more than one disease was present. *Horner* adds: The danger of blindness to the highly myopic eye increases with the age of the patient, and as a rule is always more threatening after the fiftieth year.

In other words, out of 560 cases of high myopia there were 194 cases, or 35.5%, of severe complications.

We now come to the separate parts of the eye which are affected by the complications of myopia. These we shall deal with under the following headings: 1. The cornea. 2. The lens. 3. The vitreous. 4. The fundus background. 5. The pole of the fundus. 6. The optic disc. 7. The optic nerve, pit, and ring. 8. Glaucoma. 9. Detachment of the retina.

1. THE CORNEA.—This is healthy and transparent in all cases of ordinary myopia, but an exceptional form of shortsight may sometimes arise out of a corneal opacity. During scrofular inflammation, one may perceive corneal spots with the naked eye. The form of opacity dependent on congenital syphilis, with its new formative, deep, besomlike blood-vessels will first reveal themselves to an experienced attentive observer who carefully examines the illuminated field of the cornea through a + 10 D or a + 20 D lens attached behind his ophthalmoscope. To see it the pupil must first be dilated artificially. This will give him important indications as to the treatment of the not altogether rare relapses which one meets with in this disease. Shortsight[1] can arise as a direct consequence of this disease. Cases affecting one eye are highly characteristic. In one-sided inflammation the healthy eye is at first emmetropic; later on, the second eye becomes involved, and in the course of a few months may undergo revolution; after two or three years one finds a not inconsiderable amount of myopia in the second eye as well as in the first one.

We must not omit to mention that in the highest grades

[1] On the other hand, one may get hyperopia through flattening of the cornea. See *Hirschberg*, Einführung i. d. Augenklinik, II, 1, p. 98.

of axial myopia of 20 D and over, the transparent cornea may become almost as thin as paper. If such eyes become cataractous in people over fifty years of age the greatest care must be exercised during the operation to avoid overlapping of the lips of the cornea. I have found it the safest plan in such cases to make an incision the third of a circle through the lower border. In one patient who had already had a preliminary iridectomy performed upward by one of my colleagues I found it necessary, immediately after the extraction was completed, to make a stitch through the centre of the corneal lip[1] and the scleral conjunctiva at the corresponding point opposite. This effected the apposition and the wound healed without a fault.

2. THE CRYSTALLINE LENS.—In the higher grades of axial myopia this shows regular and most important changes. These can be seen by a careful observer on looking through a + 10 or + 20 D lens behind the ophthalmoscope. Already in the thirtieth and fortieth year the eyes of the myope—but not the emmetrope or hypermetrope—frequently show bubbles or drops just behind the anterior lens capsule either isolated or in groups. Those affected with it can read the finest type close at hand without the slightest fatigue, and apart from their shortsight they are unaware of any disturbance; at most they observe the well-known muscæ volitantes. It would be a dreadful mistake for the surgeon to inform the patient that he had a cataract and thereby spoil his peace of mind. But the observation is of importance. It shows that within ten or at most twenty years before the appearance of a really disturbing lens opacity in the marvel-

[1] The finest silk and needle boiled in 1% soda solution must be used. The stitch may remain in for nineteen days without causing any inflammation.

lously transparent crystalline, the first traces of cataractous change will become visible. Years, often many, pass before the second stage of lenticular opacity is reached, i.e., the wedge-shaped opacities pass into the pupil from the periphery toward the centre, although unrecognizable to the ordinary observer by simple pupillary transillumination. Even up to this point fine print may still be read provided that the fundus shows no important changes. Even now the time has not arrived to speak of cataract. This may first be declared when actual dimness of sight comes on and worries the patient, and the suggestion as to a cure by an operation may calm and comfort him.

Cataract is more common in high degrees of myopia than in normal eyes, and comes on at an earlier stage, already in the fortieth or fiftieth year. The operation for cataract runs the same course in slight or high degrees of myopia as in normal eyes. But in the higher cases of shortsight special care is needed on account of buphthalmos, i.e., a great enlargement of the bulb, and also on account of the frequent liquefaction of the vitreous. Escape of the vitreous must be avoided, since detachment of the retina is apt to follow later on.

My former assistant, *Dr. Rau*, found from my case-books that among 1,600 consecutive cataract operations, 33 were highly myopic (10 to 30 D) before the operation. As I have hitherto been unable to find any similar list I will give the details here:

1	patient	was	twenty-three years old
2	were	between	forty and fifty
7	"	"	fifty and sixty
20	"	"	sixty and seventy
3	"	"	seventy and eighty

Males and females were in equal numbers. Fourteen

cases were operated on without an iridectomy. In 8 cases iridectomy was performed at the time. In 11 cases it was performed previously. The first operation was for the most favourable cases, the second for the intermediate, the third for the unfavourable ones. In 4 cases chloroform inhalation was given, but some of the cases occurred before 1884, i.e., before the time of cocaine anæsthesia. In the later cases, chloroform was only administered in specially irritable patients, or by reason of unfavorable conditions due to the highly myopic eye. No cases of prolapse of vitreous occurred. In one case a stitch was required, as already mentioned. No wound infection occurred. In two cases the tension increased during the healing process; in one case a month after the extraction, and six days after the secondary discission, in the other case (30 D) in which particles of capsule were left behind two and a half months after extraction. In both cases lasting recovery took place under physostigmatin instillation. In no case was retinal detachment observed. Twenty-one cases out of the 33 remained under observation for a long time.

TABLE SHOWING THE TIME DURING WHICH THE PATIENT REMAINED UNDER MY OBSERVATION

3 cases for 1 year	3 cases for 5 years
5 " " 2 years	2 " " 6 "
2 " " 3 "	3 " " 7 "
3 " " 4 "	

Test types after extraction showed emmetropia in 4 cases. In these cases there was a previous myopia of 20 D. In 2 cases there was a hyperopia of 1 D, in 3 cases hyperopia of 2 D, in 3 cases hyperopia of 3 D, in 4 cases of 4 D, in 6 of 5 D—in the last group there was a myopia of 10 D before the cataract commenced.

In many cases shortsight was actually demonstrated after the cataract wound had healed. In one case myopia of 1 D was found, in two cases 2 D, in one case 3 D. In another as much as 6 D. In the latter case the patient had a myopia of not less than 33 D before the cataract was formed. In 5 cases the existing myopic changes of the fundus before the operation were so advanced that an exact determination of vision could not be made. The acuity naturally varied with the degree of fundus change, and ranged between good acuity and counting fingers at a few feet; the last condition occurred in certain cases with very pronounced changes in the fundus. Generally speaking, the patients were quite contented to be freed not merely from their cataract, but at the same time from their extremely disagreeable shortsight as well.

At all events these results were in many cases much better than those obtained by the operation for the cure of myopia in eyes which possessed good vision. I shall refer to this subject again.

In the rest, the lens opacity of myopic eyes has a further interest; it concealed the fundamental mischief existing in the vitreous. All myopes whose lenses begin to blur complain of flakes and muscæ in the field.[1]

I shall refer later on to the lens opacity which follows after detachment of the retina. Finally I have to mention the slight shifting in position of the lens, or subluxation

[1] But this also happened to very many cataract patients who were not myopes, but then they were also troubled by muscæ at the very commencement of cataract formation. The ancients (Greeks and Arabians) declared muscæ volitantes to be the earliest signs of cataract formation. At the present day we hear very little about this, because much more reliance is placed on the objective signs, while neglecting the subjective statements of patients.

as it is called, which often accompanies the highest degrees of myopia. The lens may, notwithstanding, be quite transparent and the eye free from tension. It is highly important to notice the trembling of the iris on rotating the eye. As the detachment progresses, on cautiously dilating the pupil—which as soon as the diagnosis is confirmed can again be retracted by instilling physostigmin (eserin sulphate) as follows:

℞ Physostigmini salicyl.....0.01
Aqua destil 2.5

and rotating the eye, say toward the nose, we may recognize the well-known appearance of the border of the lens and certain dark curved stripes at the border of the enlarged pupillary field. This condition may remain unaltered for years. It may, however, induce tension of the globe; which requires an iridectomy should it threaten to damage the eye. The operation should be made on the side on which the iris appears to be bulged forward, i.e., on the temporal side, if the lens margin is visible toward the nose. The dislocated lens may also become cloudy. This does not take place so rapidly as one would suppose; by no means so rapidly as is the case when the lens is dislocated through an injury. It may take ten years in a man in middle life, when even the lens opacity in the second eye becomes so dense that he is practically blind with it, and requires an operation to be freed from the cataract. The operation for this trembling cataract requires the greatest care. One should perform the preliminary iridectomy first in the one eye and then after eight days in the other, and after which one removes the first cataract. The second one only after an interval of one to two weeks. The flap section, which should not be too small, should extend exactly through

the sclero-corneal margin under careful local anæsthesia and with a delicate hand, so that the dreaded prolapse of vitreous may be entirely avoided. By this means both surgeon and patient will be rewarded by the happiest results and the patient will enjoy better vision than he has experienced for twenty years.

In other case the process terminates with dislocation of the lens downward into the vitreous. Should the lens have been fairly clear, the shortsight will now be found to be spontaneously removed. In case the lens, as often happens, has become more or less opaque, then the myopic cataract will have become cured by nature. Occasionally the cure is complete and the patient is entirely satisfied. At times structural alterations at the centre of the retina occur, which disappoint both the surgeon and the patient; the eye sees but imperfectly. These marked displacements of the lens may also be accompanied by attacks of glaucoma, which require the application of physostigmin drops, but these, even if accompanied by a sclerotomy through the lower part of the corneal border do not always allay the tension. The removal of the lens which lies at the bottom of the vitreous is of little avail, since it cannot be fished out without considerable loss of vitreous.[1]

Generally speaking, the spontaneous dislocation of the lens, which slowly develops in this stretched-out globe, being the work of nature, is much better borne than that which

[1 Nearly all English and American ophthalmic surgeons maintain that a lens which has dropped to the bottom of the vitreous, must be removed immediately at any cost—even at the risk of losing a considerable amount of vitreous—since the lens acts as a foreign body, and sets up inflammatory changes which *inevitably* terminate in the loss of the eye, and sometimes even lead to the loss of its fellow through sympathetic ophthalmitis.—*Translator.*]

we perform suddenly with our hand, as for example in the old method of couching, or that which is executed just as suddenly and much more violently by a non-penetrating injury to the globe. But even in highly myopic eyes alarming manifestations of increased tension may arise, especially when the dislocated lens drops into the anterior chamber. If sight is still left the lens must be withdrawn under anæsthesia through a corneal flap incision. If, as usually happens, the sight is already extinguished, the best way to relieve the patient from his intense pain, and the further danger of sympathetic ophthalmia is by eviscerating the globe [or, better, by enucleating it.—*Translator*].

I myself have observed all these phenomena.

3. After the lens we come to the VITREOUS.

Opacities of the vitreous which lie in proximity to the background of the eye, throw shadows on the retina, especially when the patient looks at the sky or any extensive bright surface. These shadows are projected outward into space by means of our sense perception, and appear as an external object. The patients imagine it to be due to a hair, until they become convinced that the cause of the object seen by the eye lies in the eye itself (entoptic phenomenon). Of course the projected shadow-image is seen inverted. Should light or shadow fall on a point on the lower part of the retina, the cause of it will be projected on the upper part of the visual field. The common very delicate forms resembling strings of pearls and which are rarely absent even in healthy eyes, become more abundant and noticeable in the myope. They vary between $\frac{1}{30}$ and $\frac{1}{200}$ mm. in breadth and 1 to 4 mm. in length, and lie between $\frac{1}{4}$ and 4 mm. from the retina.[1]

[1] *Helmholtz*, Physiol. Optik, 2d Ed., p. 190, 1896. Einführung, I, 2, p. 177, 1902.

They are remains of the embryonic cells of the vitreous which have remained behind during its gelatinous transformation.

The ophthalmoscope, which only gives a magnification of from fourteen to twenty times, is insufficient to bring them into view. If we look upward they follow in the same direction, passing somewhat out of the field and then slowly sinking down. In reality they ascend, since they are specifically lighter than the liquid in which they float.

In the higher cases of myopia, the images are very abundant and coarser[1] and are described as insects or flies and the like, i.e., as dark bodies with more or less numerous long processes which hover and dance before the eyes. These we can see quite well with a convex glass behind the ophthalmoscopic mirror, especially on artificially dilating the pupil. By means of the power of the lens required to bring them into focus one may calculate the position of the bodies in the vitreous. It occasionally may happen in a highly myopic eye if the particles lie very far back, that a concave glass may be required. Most of the cases of movable branched opacities seen in the vitreous occur in high myopes. Occasionally the opacities rest against the background of the eye. They adhere in the form of branched threads attached to groups of cell deposits which result from excessive myopia, and moreover become one of the factors of retinal detachment.

It is generally believed that an inflammation, or an in-

[1] These have been endowed with the dreadful name myodesopsia. Even if we say μυιοειδὴς ὄψις, which is more grammatically correct, the idea is erroneous, since it is not the act of vision which resembles flight, but the thing seen (μυῖα, a fly). The French expression, "mouches volantes" (muscæ volitantes), is superfluous.

flammatory exudation of these vitreous opacities is the cause of the detachment, and the treatment is based on this supposition.

I should like first to warn you against applying the instrument used to combat inflammation against these vitreous opacities. It is absolutely useless, and often enough it acts injuriously. This is performed by withdrawing blood from the temples by means of *Heurteloup's* artificial leech. In every case it produces ugly scars, and occasionally anæmia is the result of this treatment.[1] Rest to the body, screening the eyes from light, avoidance of glaring lights, and strong light contrasts, protective (smoked) glasses, harmless and comforting prescriptions, such as Fachinger mineral waters, and solutions of bromides and iodides of soda internally. These are the means which I prefer to take, and which appear to me to be more suitable.

The large vitreous opacities when once formed may readily become smaller and even appear indistinct to the patient, although they hardly ever disappear, even after ten years.

They are not of an inflammatory nature. As the stretching of the globe, which is the cause of the high myopia, tends to rupture the vitreous structure, fluid must immediately flow into the gaps thus formed. This rinsing and internal shrinking will have the effect of altering the loosened part of the structure.

Sometimes the muscæ appear suddenly. In this case we must beware of hemorrhages. It is certain that we frequently console the patients by referring them to a ruptured vessel. But this does not take place in all cases.

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[1] Einführung, II, 1, p. 176.

A case of muscæ volitantes is very clearly recognized.[1] If a high myope, who is liable to venous stenosis, suddenly perceives a musca, and goes at once to the surgeon, he will find, provided he has examined him sufficiently carefully, that the musca is covered with blood, i.e., that a retinal hemorrhage has produced a shadow-image in the vitreous. This prediction is true as a rule, and the shadow may remain for a long time, perhaps even forever, although diminished in size. The treatment must depend on the determining cause, while corpulence, constipation, and the like must be combated by suitable means.

4. THE BACKGROUND (fundus) of the highly myopic eye. —This is only to be perceived by the direct method of ophthalmoscopy (upright image), with the assistance of a correspondingly strong concave glass behind the oblique mirror. Unfortunately this method of investigation, which in any case requires a good mirror and considerable practice, is not always possessed by either teachers or pupils, although it is worth practising on account of the rich stores of information which it affords.

The inverted image (indirect method) of the highly myopic fundus varies in position from 2 to 6 inches (5 to 15 cm.) from the patient's eye and may be well observed by the surgeon at a distance of from 12 to 16 inches (30–56 cm.). Indeed, if the observer, as he should do, has learned to relax his accommodation he may employ it to measure the degree of myopia objectively, almost as readily as by the erect method.

In the indirect method one holds a lens of 2 and 3 inches (i.e., 20 D and 13 D) in front of the patient's eye, so that by

[1] Einführung, II, 1, p. 178

means of reduced magnification and extended field one may be able to cover the entire fundus. Should changes of a more important character be discovered, one must again revert to the upright image in order to get increased magnification.

Artificial dilatation of the pupil by means of homatropin is indispensable in many cases for the purpose of exact diagnosis; only when the examination is over, one must not omit to contract the pupil again by means of physostigmin (eserin) drops. I cannot believe that dilatation of the pupil is a matter of indifference to the myope. I have often had great complaints of the reduced acuity brought about by it. Such patients, who are mostly neurotic, should be allowed to wait after the instillation of the physostigmin until they become convinced of the groundlessness of their complaints. Moreover we cannot suppose for a moment that the rare, but still real dangers which follow the artificial dilatation of the pupil, especially in hypermetropia, disappear entirely in myopia. At all events in using these drops the strictest asepsis is requisite, and this can best be brought about by boiling the dropping tube and by heating the closed bottle containing the solution in a steam oven.[1]

In the next place we must turn our attention to the OPTIC NERVE ENTRANCE, which not only serves as the polar star and measuring chain for the entire survey of the fundus, but also as being the sum total of the collective light-bearing nerve fibres of the eye, forms the most important spot of the fundus, and which in the ordinary

[1] If the general practitioner has not the apparatus at hand, the chemist can see to it for him. [No steam oven is necessary. All that is required can be just as efficiently performed by boiling the solution in a teaspoon or test-tube over a spirit lamp.—*Translator.*]

text-books carries the equally false and stupid name "papilla."[1]

The round pinkish head of the optic nerve, together with the commencement and termination of the retinal vascular system lies in the gently curved plane of the surrounding retina. In the centre is a slight depression—the harbour for the blood-vessels. In high myopia this nerve-head becomes altered in two ways. Firstly, there is a change in its shape, the circular boundary becoming changed into a vertical ellipse, which on account of the oblique insertion of the nerve appears to be narrowed by perspective in the axially elongated eye,[2] and secondly on the temporal border a bright crescent-shaped stripe (conus)[3] is added, just as we can imagine a crescent increasing until it made a contact with the disc of the full moon.

According to *Schnabel* and *Herrnheiser*[4] this crescent is congenital even when it extends to a girdle. If the diameter

[1] Papilla = breast-tit. No swelling exists at the entrance of the nerve in the healthy human eye; in the anatomical preparation it constitutes a post-mortem change. The name papilla nervi optici appears to have been given by *Winslow* (1732 to 1766). But *Zinn* and *Brücke* expressed their doubts about its form. (*J. G. Zinn*, Descr. oculi hum., Göttingen, 1780, p. 96, and *E. Brücke*, Description of the Human Eye, Berlin, 1847, p. 61.)

[2] On the nasal side of the optic nerve, about one mm. distant, one may notice in the upright image, especially among young myopes, a bright, shining, curved, reflex band, which is a sign of a fine commencing vitreous detachment. This was first described by *L. Weiss* in 1885.

[3] It is called a cone or conus, probably because it is hardly ever conical. A bright crescent, exactly beneath the disc, is congenital. It is due to the late closing of the fœtal cleft, and is connected with high astigmatism. An irregular light yellow, girdle-shaped stripe surrounding the disc is the result of tension (glaucoma). A still larger circle sometimes occurs in old people, sometimes even in otherwise perfectly normal eyes. The first named variation is called the *conus inferior*, the second the *glaucomatous* ring, the third *senile staphyloma.*

[4] Zeitschr. f. Augenheilkunde, 1896, xvi.

of the choroido-sclerotic canal is larger than the diameter of the nerve-head, the ophthalmoscopic appearance shows a white girdle, which denotes a defective formation on the two outer coats around the optic nerve. A similar defect confined to the temporal side forms the crescent. According to *J. Stilling*,[1] the white half moon is the appearance in perspective of the distorted wall of the neural canal. One may readily demonstrate it, by considering one's arm to be the optic nerve, and the shirt-sleeve as the sheath; if we now pull the latter a little to one side and look inside it, the part which is dragged to one side when seen from the front will look like a white crescent.

Both views are partly true, but do not comprise the whole truth. Observation teaches us that as one grows older and the degree of shortsight increases, the crescent is more often seen, and, if present, grows larger and spreads round to form a girdle. Indeed that was admitted by the discoverers of the appearance just described. Allowing that the formation is congenital, the growth of the bright patch depends on thinning (atrophy) of the choroid and is caused by the stretching of the myopic globe.

The crescent is occasionally found in low degrees of shortsight, more frequently in medium degrees; in the higher degrees it is only exceptionally wanting, especially in ripe age.

Stellwag found an absence of crescent only twenty-one times in 220 cases of high myopia (from 6 D to 20 D), i.e., in 10% of the cases.

The fact that *Schmidt-Rimpler*, in his investigation of the sight in schools, found the crescent absent in 20% of

[1] Die Kurzsichtigkeit, Berlin, 1903, p. 34.

myopes of 6 D is no contradiction to the statement. *Schleich* found in 1,020 myopes 18% without a crescent, 42% with a slight crescent, 22.5 with a broad one, and 9.5% with a ring round the nerve. *Schnabel* found in 135 cases of crescent formation, 99 in myopic eyes, or 74% in all.

One may often watch the progress of the change by noticing that the original bright crescent is joined on by others of a more brown or yellow colour. In children the crescent is rarer and usually small; in myopic adults over 6 D its breadth already exceeds the disc (i.e., over 1.5 mm.). In exceptional cases its breadth extends to 6 mm. and over, i.e., it extends a considerable distance beyond the foveal pit, the spot of most acute vision, which lies about 3 mm. distance from the temporal border of the disc. Furthermore a bright ring extends from it round the disc. This has a variable breadth, usually widest on the temporal side, having an irregular border outside covered with islands of pigment, and not uncommonly atrophic changes on both sides of the centre of the fundus exist, as well as at the periphery and between the two.

This choroidal atrophy, which certainly progresses in sympathy to a marked degree with the portions of the retina lying in front, had arrested the attention of the observer long before the epoch of the ophthalmoscope and received the name of staphyloma posticum.[1] This was declared to be the chief sign of the highest degree of myopia and dependent on an inflammatory condition, the so-called sclerotico-posticus.

[1] Staphyloma literally means a bunch of grapes (σταφυλή, a grape). It should be a cluster of berries, as so named by the ancients. See my Dictionary of Ophthalmology, 1877, p. 99. At the present time it signifies any padlike swelling on the globe, wrongly applied to the light crescent or ring-shaped spot at the margin of the myopic disc.

This theory of inflammation is an error, which has had most injurious consequences. Thanks to this supposed inflammation numberless patients, especially women, have been ordered artificial leeches in addition to perpetual confinement to a dark room and bloodletting, which tended to a highly nervous condition. It is high time to break loose from this purposeless and cruel treatment, which cannot, either according to experience or theoretically by a process of extension, be shown to be of the slightest value. Bodily rest and screening the eyes from light are the only prescriptions which seem to be of any use in order to help toward a favourable termination of the process of stretching.

The crescent *per se* interferes very little with vision. Even when it has extended somewhat, it only causes at first a slight enlargement of the blind spot area, which is quite unnoticed by the patient, since the field of the other eye, so to speak, will fill up the gap.

It is only when the crescent (or ring) reaches the macula that impairment of sight begins. This becomes very troublesome, indeed disastrous when the choroidal atrophy round the disc, and that in the centre of the fundus, fuses with the large bright leaflike figure of the so-called staphyloma posticum, the result being that all acute vision, such as is required for reading and writing, is lost to the eye and only the coarse outlines of objects remain, which merely suffice to allow the patient to find his way about, and not even then in awkward places.

5. POLE OF THE FUNDUS (macula region).—We now come to the changes at the centre (pole) of the fundus, which at first are distinct from those at the disc, since, as a rule, they appear later (especially those in which the stretching process comes to a standstill), and, unfortunately for the patient,

are unaffected by treatment. Further, those patches which are locally most advanced remain separated from them and spread in parallel lines with them, until eventually both groups fuse by extension and combine to form the above-mentioned picture—the staphyloma malignum.

The changes which appear at the commencement of this fifth series of disturbances begin by a diminution of the pigment at the centre of the fundus where the background is markedly lighter than the field of the wound. Then long white lines or thin stripes are formed which are often branched or folded, and which appear to be pigment mixtures, i.e., clefts and rents in the connecting stratum of the pigment epithelial layer, which lies between the retina and choroid. These white stripes become broader and longer and form borders of pigment and islands. Bright white, or lightly dappled grey spots appear, and a greenish-grey round or foursided figure, about 2 mm. in diameter, may be seen in the very centre of the field, with larger or smaller retinal hemorrhages. These latter must not be mistaken for the reddish remains of the normal background, which surround the light and dappled patches. Hemorrhages appear to be much more abundant than they really are, especially by those who have not mastered the upright (direct) image. But in doubtful cases of central retinal hemorrhages, I was able, by protracted observations continued for weeks and months, to establish the fact that the blood gradually disappeared and a dappled grey figure of horseshoe form with a clear centre and light surroundings took its place (usually occupying the centre of the patch).

As soon as the change has arrived at this degree of intensity, it begins to advance. If one makes a drawing every year of the same fundus one may observe that this pigment

change extends in area no less than in intensity, the colour contrasts becoming more decided, or the darker parts become nearly black, while the lighter parts approach white in colour.

The manifold characters of the individual appearances can be shown better by coloured drawings than described.

But, fortunately, now and then, in spite of the enormously extended pigment change, some vision still remains, although but a sorry amount. Only in a few cases will the entire macula area be free from these progressive changes (although for the oculist with a large clinic these amount to a very considerable number). But we must never lose sight of the fact that this is the most valuable part of the fundus, as it supplies the whole of the defining power.

A. v. Graefe, Vol. I, 1, 390 of his Archives, had already established the fact that of all the amblyopic forms of disease, those produced by the changes wrought in myopia were the most abundant; in fact, he found them 420 times in 1,000 cases. [The macula region is, unfortunately for the patient, the seat of election of pathological changes in the fundus.—*Translator.*]

Among children in the first year of school, disturbances of the centre of the retina are generally speaking rare. Nevertheless I have observed both single and binocular cases often enough to become convinced of their importance, both by their prevalence at this tender age, as well as by the chance afforded of a preventative treatment being applied. Heedless of all considerations of rapid advancement in learning, as soon as I see the first indications of these important changes, I set aside all ordinary school teaching for the next one or two years, or replace it by a mild and special form of instruction, or home teaching, which should be chiefly oral

in character, and all copybook-writing and prolonged study entirely excluded. If this advice should fall on fruitful soil the evil consequences will not follow. The progress of the changes will either cease, or will become unnoticeable, so that after a couple of years one may again increase the amount of study, although of course in moderation.

More frequently the above changes appear during puberty. Especially is this the case in anæmic seamstresses. One is obliged to compel them as speedily as possible to renounce their eye-destroying business.

Unfortunately during middle life high myopes are by no means rare. Such eyes in which the myopia exceeds 10 D, whose far point therefore is at 4 inches, or 10 cm., will only exceptionally be found quite free from disease, provided the patient is over fifty years of age.

The disturbances of vision which occur in these ocular changes, or are dependent on them, are numerous.

In the first place we notice the reduced power of continuing work. This is often wrongly diagnosed, for in the highest myopia the loss of the muscle balance (the marked outward squint) which is hardly ever absent, is met by setting back the insertion of the external rectus muscle in the most shortsighted eye (or even in both); a mistake which the surgeon will soon notice, for he will find it to be the *internal* muscle which is at fault, if he carefully observes his patient whom he has failed to benefit.

The next point is micropsia (seeing objects too small). In the fovea some of the cones become pushed aside. The image of small type may comprise, let us say five cones at the reading distance in the sound eye, but which only cover three in the diseased one. The patients themselves say that the type is reduced from three-quarters to half the

size.[1] Should the difference be still greater the letters will appear distorted. Straight lines will appear crooked or wavy, certain letters in type lines are seen to be pushed out of register.

Gradually the catastrophe gains the upper hand. Certain letters fall entirely out of line, near or at the point of fixation. Finally, a large dark spot appears right in the centre of the field (scotoma centrale). Reading and fine work become impossible, but the patient can still see to get about.

These changes in the macula area are known by the name of RETINITIS CENTRALIS MYOPICA. This name is not merely barbaric, since it is compounded of an unlatin adjective retina (= retiform), which is a noun (*reta*, a net) twisted into an adjective, and to which a Greek termination, = ῖτις, is appended; but entirely erroneous, since it deals with a stretching of the coats, which has nothing in common with inflammation.

A. v. Graefe, in 1854, thought that the cause of the mischief lay in an inflammatory process of the choroid and sclerotic, and although he failed to find any definite inflammatory products in these coats, he introduced the name sclerotico-choroiditis posterior, and supported it by the good results of antiphlogistic treatment. *Donders* declared again, in 1866, in his classical work on "Refraction and Accommo-

[1] The proof rests on the following measurements: A fairly large, long rectangular white stripe on a dark background is looked at from a distance of 2, 3, or 5 metres, as the case may be. The patient wears his distant glasses. A prism of 8°–10° is now placed before the sound eye with the thin edge* toward the nose, so that two images are seen side by side. In this way the comparative apparent size can be readily estimated.

[*This appears to be a misprint for thick edge, since the thin edge of the prism, in a case of crossed diplopia due to exophoria, would only separate the images still more.—*Translator.*]

dation," that in the higher degrees of shortsight an inflammatory condition was almost invariably present. Great as these two men were, Truth is still greater.

A much more correct view was published so far back as 1861, by the genial and far too much neglected investigator, *Ed. v. Jäger*, in his admirable work on the construction of the optical apparatus, in which he says that the so-called staphyloma posticum is based on a congenital formation, which with the associated disappearance of the choroid increased with growing elongation of the globe; but it may, up to a certain degree, remain stationary.

This false notion of retinal inflammation has, I am convinced, only brought disaster upon myriads of myopes. If, for example, we treat a pale and badly nourished needlewoman with repeated abstractions of blood from the temples, presumably by means of the Heurteloup artificial leech;[1] if we further keep the unfortunate patient for weeks at a time locked in a dark room, prescribe hot mustard or aqua-fortis baths for her feet, mercury ointment inunctions on the forehead, and administer iodides, etc., internally, by which one supposes that one is able to relieve inflammations of distant organs far removed from the point of application, then I can only say that this treatment is far removed from our ideal of genuine therapeutic art.

I soon shook myself free from such erroneous doctrines which were transmitted to me by my teachers. I transferred

[1] It was owing to the ancient penetrating superstitions handed down by the Greeks and their learned scholars, the Arabians, who again became the instructors of the Europeans, that bloodletting in the neighbourhood of the eyes appeared quite indispensable for inflammations of the eye, and it is owing to the modern schools that for external ocular inflammations we are told to employ natural leeches, for internal inflammations artificial ones. See my Einführung in die Augenheilkunde, I, p. 22, 1892.

the Heurteloup from my practice to the museum, and followed another therapeutic method, which in suitable cases is likely to prove of considerable value.

The first point is to completely stop all near work, such as sewing, embroidery, writing, drawing, painting, etc., for a long time. Children should be taken away from school for at least a year, and chiefly learn by ear. Needle-women must be advised in another way. Practitioners must give up private study. Lawyers must have their documents read to them. Ladies must entirely forego their novels, and lady artists their stooping, if not their hobby. The surgeon naturally cannot enforce these things, he can only advise.

My uninterrupted observations, especially in my private practice, and my carefully entered clinical notes, carried on for more than three decades, have given me the comforting conviction that by means of a long-continued abstention from close work the stretching process can be so far arrested —indeed, relatively speaking, it is by no means rare for it actually to be brought to a standstill—that further diminution of acuity will not occur. It is true the pigment change, which is the real object of our ophthalmoscopic investigation, may still progress somewhat further and frequently does so.

Especially instructive are those cases of high myopia of about 10 D and over occurring in advanced life beyond fifty years of age, with strongly marked changes in both eyes, so that the worst eye of the two has already ceased to read fine print.

If during the period of eye trouble, a steady progress for the worst has been noticed by the patient himself, but during a period of rest no alteration for the worst has occurred, and later on by carefully regulating the conditions of work no further change has occurred for ten years, then

both the surgeon and patient may be thoroughly satisfied. On the other hand one cannot dismiss the idea that the period of rest has been of benefit to the diseased organ, for the same forces which caused the stretching will also maintain and assist the eye by reason of the healing power which nature possesses when the injurious influences are removed or at least diminished.

It stands to reason that when the progressive changes have been arrested, one may again permit a certain amount of work, in fact one often must do so, especially in the case of children and young people. It is just in these latter cases that the longer periods of rest effect a lasting cessation of the stretching of the eye. Holidays, summer resorts, and the like are just as beneficial to high myopes as exhausting occupations are injurious.

If, apart from this hygienic method of living, we resume this "eye training," we should adopt a plan of treating the body rather than the disease, which acts indirectly in a beneficial manner by soothing and sustaining, a plan which should never be neglected at any time. For children I prescribe syrup of iodides or cod-liver oil, for anemic girls suitable iron preparations, and for older men Fachinger mineral water and the like, and occasionally bromides or iodides of soda.[1]

[1] One must never mistake the so-called retinitis myopica for an actual specific choroiditis. High myopia cannot clash with syphilis. The view of many surgeons is confused. If you pay attention to the choroidal changes at the disc, which are unquestionably dependent on myopia, you will readily perceive that the densely crowded pigment-dappled collection of cells in the centre of the fundus have an entirely different origin. I have observed and published from time to time a whole row of such cases, and followed them up for many years both in children suffering from congenital syphilis and in adults with acquired syphilis, which of course were treated conformably with the main disease. [For a characteristic drawing of pigment changes occurring at the macula, see a coloured plate by A. W. Head in my "Pocket Atlas of the Fundus Oculi."—*Translator.*]

Even the injection of normal saline solution under the conjunctiva, which has been recommended in recent times, and effusively praised by some of our colleagues, belong, according to my experience, only to the relieving and not to the curative class of drugs. Still they cannot be dispensed with entirely. Many patients call for them urgently, for they are at least firmly convinced that they were of the greatest value in an early stage of their disease, possibly by the other eye. By numerous, sufficiently long-continued and carefully recorded experiments, I have convinced myself that they have no essential value. For this reason when one employs them generally, one must manage things so as not to cause any severe pain, and do no damage.

As, however, they have to be considered in connection with the retinal detachment provoked by high myopia, I will dwell on it for a moment.

The first point is strict asepsis. Both the syringe and the needle, as well as the forceps used to pinch up the conjunctiva, must be freshly boiled in water. Only solutions which have been sterilized by the steam chamber should be used. Sublimate solution 1:5,000 should be dismissed.

Physiological salt solution (0.6%) is employed.[1] A syringeful, i.e., one gram (1 c.c.) of the solution, may be injected two or three times a week for a few weeks. Just before the injection a few drops of 1% sterilized solution of cocain or holocain should be dropped into the conjunctival sac to render the part insensitive. That acoin can effect this purpose is nonsense. After one or two weeks one may increase the strength of the salt solution to 2%, but it will no longer be free from pain.

[1 Physiological salt solution is usually understood to be somewhat stronger, viz.: 0.75% to 0.80%, and in England, at any rate, is used of this strength.—*Translator.*]

The assistant draws the two lids gently away from the globe; if no assistant be available one may use an eye speculum. The surgeon now seizes a fold of the ocular conjunctiva between the equator of the globe and the corneal margin with the toothed pincette; draws it up in a tentlike fold, and inserts the needle of the syringe just beneath the pincette, right through the conjunctiva into the space between the latter and the eye, and slowly empties the contents of the syringe into it. This causes the conjunctiva to swell up in the form of a small bladder. One then carefully closes the lids over it without any squeezing, and covers it with a light bandage for half a day. When this is removed in order to replace it by a freshly folded linen pad, which should be held in place by a bandage across the forehead, all traces of the swelling should have vanished and the eye should be free from inflammation and white. (One must take the precaution to avoid sticking the needle into one of the small, but quite visible blood-vessels in the conjunctiva.)

6. THE OPTIC DISC.—It would be certainly remarkable if the optic nerve should remain entirely unaffected by all this stretching and all these serious changes in the central field of the retina, seeing it is so richly provided with fibres of the optic nerves. Naturally this is not the case.

We have, however, to make an important distinction here between simple well-marked changes in the appearance of the disc, which never affect the function of the nerve, and diseased conditions which are connected with injury to sight.

To the first class belong the apparent shortening of the horizontal diameter of the optic disc, which is pushed to the nasal side, owing to the stretching of the disc in the region of the posterior pole, and which we invariably perceive obliquely through the ophthalmoscope. By a greater amount of

stretching the horizontal diameter of the disc can become actually shorter than the vertical,[1] since, owing to the crescent lying below, the latter may be found fairly regularly longer. To this belongs the so-called supertraction crescent, a delicate half moon on the nasal side of the disc, and lastly, the displacement of the retinal vessels and the extended course of their principal branches, toward the nasal border of the physiological pit.

In the second class we have paleness and excavation of the disc, either alone or coupled with increased tension. It is almost incredible to think how often these diseased changes are overlooked or neglected. At any rate the difficulties of diagnosis are much greater than by similar alterations in emmetropic or hypermetropic eyes. The upright image which requires a good mirror and a practised observer in the higher degree of myopia, is not altogether appreciated. The entire neighbourhood of the nerve, especially in the inverted image, is so brightly illuminated, owing to the extended disappearance of the choroid, that the delicate change of colour of the nerve substance vanishes. Many surgeons are so constituted that when they think they have found sufficient reason for any appearance. They see no reason to seek still further for a second contributary cause.

A large number of exact observations, extending over a period of twenty or thirty years, have shown me that this pale excavation of the disc in one series of cases which belong to the highest form of myopia, depends on a partial disappearance of the optic nerve, owing to the loss of numerous fibres which have fallen a sacrifice to the extended alterations at

[1] *R. Liebreich* (Arch. f. Ophthal., VII, p. 125, 1860) found, by micrometric measurement, that the vertical diameter was as large again as the horizontal one.

the centre of the retina. This condition requires the same comprehension and judgment that we have already conceded to the fundamental evil, viz., the atropic stretching at the centre of the fundus.

But in a second class of cases the pale excavation of the disc in high myopia is the expression of a special form of increased tension, viz., glaucoma myopicum, and requires a special form of treatment which I shall shortly refer to.

7. CAVITY OR PIT.—That which appears as a prominence in an anatomical examination of the region of the posterior pole of a highly myopic eye will of course appear clinically as a cavity or pit when seen with the ophthalmoscope on the inside.

Either, firstly, the region of the light crescent or a ring-shaped band round the disc will merely appear somewhat sunk; or one may recognize round the disc by its extended yellow coloration (choroidal atrophy) a semicircular or semielliptical sharp border-line of the cavity a few millimetres on the nasal side of the disc margin; while on the temporal side a very gradual slope is seen; or, secondly, the entire back surface of the fundus will be occupied by a large circularly bounded pit which lies in the centre of the disc.[1]

[1] Since both these last-named sharply demarcated bulgings which in *v. Graefe's* Klinik we were accustomed to call true staphyloma (*Scarpa's* staphyloma) became entirely forgotten, until *L. Weiss* and *Masselon*, and after them *Caspar* and *Otto* (Arch. für Oph., XLIII, p. 553) again called attention to them, I should like to add the name of my colleague, *C. Hess* (Acc. u. Refr., 1902, p. 316). Both of us were always familiar with it. Already in 1876 (Arch. f. Oph., XXII, p. 66, and again in 1877 in the second part of my contributions, p. 59) and in 1878, in my statistics of eye diseases in my Dictionary of Ophthalmology, 1887, p. 100, I have dealt with this view as being a perfectly current one, and I possess many dozens of fundus sketches together with the visual fields in my case-books. The condition is not so rare as *L. Weiss* has supposed. In myopia of 20 D and over one invariably finds it, and in the majority of cases in myopia of 15 D.

All the more deep formed pits of this kind impair acuity, and especially the extent of the visual field.

The last-described form occasionally brings about almost total blindness of the affected eye.

Treatment is powerless in marked deformities of this kind. One can only take pains, as far as is possible, to keep the high increase of myopia within bounds.

8. RISE OF TENSION (glaucoma) is certainly more common in emmetropia and hyperopia than in shortsight. But on the one hand the active causes of ordinary increase of tension are much more powerful than the protective beginnings of myopia, especially the medium degrees, so that in myopia increase of tension occurs more rarely than in hyperopia, although it is by no means entirely absent; on the other hand there are some special varieties of glaucoma which are peculiar to the highly myopic eye.

Although *A. v. Graefe*,[1] so long ago as 1858, had clearly made known the transformation of sclerotico-choroiditis into a glaucomatous condition, and *R. Liebreich*,[2] in 1860, and *Donders*,[3] in 1866, had called attention to these diseases, and although I myself,[4] in 1877, referred to myopic glaucoma and described it in my statistics as a special form,[5] still these cases are persistently ignored even to the present day; a fact which I have had repeated opportunities of observing in patients who have come to me both from near and foreign lands.

I will not waste much time over hypotheses. The reader

[1] Arch. f. Oph., IV, 2, 153.

[2] Arch. f. Oph., VII, 2, 128.

[3] Refr. u. Accom., p. 338.

[4] Beitr. z. prakt. Augenh., II Heft, p. 59. Arch. f. Oph., XXIV, 1, p. 191.

[5] Beitr. z. prakt. Augenh., III, p. 104, 1878.

may have expressed surprise that in cases of high and increasing myopia it is the macula region, i.e., the region of the posterior pole that gives way, and not the less resisting optic nerve. The surprise ceases when one assumes more correctly that the region of the posterior pole is, as a matter of fact, the most yielding. But the limits of the elasticity of the sclerotic and choroid coats can be overstepped, especially in advanced life; then the case becomes reversed, the nerve yields and becomes excavated, the pressure can be increased either by external alterations in the form of the eye, and its results such as rupture of choroidal vessels, or by alterations of the tissues internally, such as by the atrophy of large areas of the choroid and its blood-vessels. In either case glaucomatous symptoms may arise.

The clinical facts are as follows:

There are three principal forms of true myopic glaucoma. The *first* runs a chronic course, but still with occasional attacks of increased pressure, which cause dimness of the cornea, as well as cloudy and rainbow circles. The *second* runs an identical course with simple chronic glaucoma; it exhibits without any inflammatory signs, merely increasing shrinkage of the field, impairment of vision, as well as excavation of the disc and perceptible increase of tension to the touch. The third runs a similar course to the second, but shows near the excavation of the disc, still a marked depression in the form of a ring occupying the background encircling the disc. It is especially destructive and apparently incurable by means of an iridectomy.

I will illustrate my remarks by a few examples:

I. (1.) On January 15, 1900, a gentleman, aged thirty-nine, came from a western province with a letter from his oculist in which doubt was expressed as to whether the eye

was suffering from brain disease, tobacco amblyopia, or glaucoma.

He certainly had no brain trouble, inasmuch as all the symptoms were wanting, and the hemiopia in both eyes lay on the nasal side. He also had no tobacco amblyopia, since great contraction of the visual fields was present. He had glaucoma which was proved by the increase of tension to the touch, by a slight smokiness of the cornea and by a definite, but as luck would have it, an incomplete cupping of the optic nerve. The corneal dimness alternated. At 11 A.M. pilocarpin was dropped in the eye; at 3 P.M. the corneal dimness was visible, and at 8 at night it had vanished.

Vision, R. E. with $-$ 6 DS = $\frac{2}{60}$, Sn. 12″ to 6″. Visual field shrunken on the inner side as far as the point of fixation. Vision, L. E., with $-$ 6 DS = $\frac{3}{60}$, Sn. 12″ to 6″. Vision field shrunken to 5° on the inner side.

On January 17, 1900, iridectomy was performed on the right eye under chloroform, and on January 23 on the left eye. Two years after he returned. He is able to write once more. The visual fields have extended on the nasal sides to 10°. Sn. 4 can be made out. Pale cupping of the disc. Cornea clear. (After nine years almost the same.)

This was a happy result of operative treatment, which might have been much better had one been able to deal with it earlier.

I. (2.) On January 21, 1901, a young lady, aged twenty-one, was sent to me from the eastern provinces, accompanied by a letter from her oculist.

On January 31, 1900, the right eye, with $-$ 22 DS = $\frac{4}{36}$; L. E. $\frac{4}{25}$. On November 25, 1900, R. E. $\frac{1}{36}$, L. E. $\frac{1}{25}$. Visual field reduced. In January, 1901, rapid deterioration. January 8, 1901, R = $\frac{1}{25}$; L. E. = $\frac{1}{40}$. I find the shrinkage of

the R. V. field up to the fixation point. The medium-sized letters are made out with difficulty, the left eye is almost blind. Increased tension on both sides. Pale cupping of the disc, with choroidal atrophy round it and changes at the macula. I sent the patient back to her oculist—one of my former pupils, and advised him to perform an iridectomy at once in both eyes. On January 30, he performed an iridectomy on the left eye, during an altogether unexpected attack of corneal dimness, dilatation of the pupil and rise of tension. All these symptoms disappeared after the operation. On February 6, 1901, an iridectomy was performed on the right eye. After the operation the vision became decidedly improved, and particularly the extent of her visual field. There was still a tendency to a wide pupil, for which pilocarpin was instilled.

On July 9, 1903, or two years after the operation, the right eye read with difficulty Sn. 1.25 M. The visual field was contracted inward nearly to the fixation point. The left eye had P. L.[1] On both sides there was deep cupping of the disc.

If the result of the deferred iridectomy was only a moderate one, still it prevented complete blindness. Periods of obscuration came on from time to time, especially before and after menstruation, which was not altogether regular.

II. (3.) But also in our own country [i.e., Germany] myopic glaucoma is overlooked. In the following case it cost me a lot of trouble to convince the oculist who had charge of the case of the correctness of my diagnosis.

On February 27, 1903, a gentleman, aged forty-three, came for admittance, whose left eye was almost blind in consequence of retinal detachment brought on by very high

[1 P. L. is used for Perceptio lucis: light perception.—*Translator.*]

myopia, while the right eye showed continued retraction of the visual field.

On July 8, 1901, the eye could read Sn. 1½ to 2″. Visual field: inward, 45°; outward, 80°; upward, 45°; below, 60°. On January 3, 1903, the field was inward, 25; outward, 45°; upward, 20°; below, 20°. There was no other cause of diminution of the field, except a pale cupping of the nerve, and increase of tension to the touch. On February 6, 1903, I made a trial iridectomy on the left eye. Regular healing. On February 13, I performed an iridectomy on the right eye under anæsthesia. Healing without any inflammation. On July 5, 1903, Sn. 1½ to 2″. Visual field. Inward, 20°; outward, 38°; upward, 25°; downward, 30°. Tension normal. In 1909, the same.

III. (4.) A patient, aged forty-four, came, February 27, 1876, with the statement that he had been myopic since a child, but latterly his myopia had increased and his left eye had become defective. Right eye, with − 5″ Sn. = 1. Visual field normal. Sn. 3′: 2–3″. Shrinkage on the nasal side up to the fixation point. Left eye has highest degree of myopia, *excavation of the disc, together with an elliptical half circle of 0.75 mm. breadth on the temporal side of the disc, and rapid arterial pulsation, with increasing hardness.* On May 1, 1876, I performed an iridectomy. The arterial pulsation and hardness were removed, but the sight became gradually worse. On September 19, 1877, the globe became softer. Frequent changes in the centre of the fundus. So far back as 1879 the left eye became blind without inflammatory symptoms. The patient has remained for the last twenty-seven years under observation. In January, 1894, the following facts were established: From his forty-fourth to his sixty-third year the myopia of the right eye

had increased from 8 D to 11 D. The acuity had become reduced from 1 to 0.5, viz., by light lines (pigment cracks) which extended up to the centre of the fundus. The disc has a large physiological cup and a broad crescent. Tension normal. Left eye is blind, free from inflammation, but hard. The disc and a bordering half ring on the temporal side are excavated; the choroidal thinning which encroaches on this half ring has become fused with that of the centre of the fundus to a large bright figure. On October 30, 1902, the man (now seventy-one years of age) returned, for in 1901 he met with a slight stroke. The right eye is unchanged, with normal field of vision; his sight is greater than $\frac{1}{2}$. The left is blind and shows increased tension and smoky looking corneal opacity.

III. (5.) A woman, aged thirty-four, came here November 6, 1884, for admission. She was treated from her second to her ninth year for corneal inflammation, and now, since a few weeks ago, has begun to see worse, especially in the left eye. The right eye has a myopia of 13 D. Vision= $\frac{1}{1\frac{1}{2}}$. Visual field moderately contracted concentrically. The left eye counts only fingers at $\frac{2}{3}$ of a metre excentrically. The field of vision is contracted all round, on the nasal side up to the fixation point. On both sides corneal spots, and myopic changes both in the centre and periphery of the fundus; in the left eye pressure cup in the disc. On November 10, 1884, iridectomy left eye. Normal operation. Narcosis. During the next two years the little remaining vision in her left eye disappeared. In the fourth year after her operation the cornea had already become cloudy and bulged forward. The pupil dilated to maximal, the lens cataractous—in short, it presented the picture of a glaucomatous form of eye, while now pressure increased in the right eye. But the vision

(Sn. $2\frac{1}{4}'$ at $2\frac{1}{2}''$) and the field of vision remained much the same for years. It was not until January, 1897, that the contraction of the field became marked. The patient was admitted on October 4, 1897, but physostigmin drops not only contracted the wide pupil but markedly improved her vision. At her request she was dismissed. On January 12, 1898, she returned and sought for an operation. On January 14, 1898, iridectomy on right eye; narcosis normal. Healing without inflammation. February 2, 1898, Sn. $1\frac{1}{2}'$ at $1\frac{1}{2}''$; visual field: inward, 40°; outward, 70°; upward, 30°; downward, 80°. One notices the deep cup inside the broad ring-formed staphyloma. But the field contracted more and more on the nasal side in spite of the physostigmin. A year after the operation the vision became Sn. $3\frac{1}{2}''$ at $1\frac{1}{2}''$, slowly spelt. Visual field: inward, 5°; outward, 55°; upward, 20°; downward, 40°. Thereupon light and mottled clusters accumulated in the fundus, while the lens began to become cataractous. The globe remained hard. Four years after the operation she could only count fingers close at hand. At the end of 1903, all sight left her. It is difficult to say whether the blindness would have come on earlier if she had not had an operation.

I hope that these accurate notes will contribute to our recognizing better that this important form of disease, although a rare one,[1] is nevertheless a most important consequence of the highest degree of myopia, and that in its tractable forms can also be operated on and cured. General anæsthesia is essential for all operations on such markedly lengthened and consequently highly stretched globes.

9. The worst consequence of high degrees of myopia,

[1] Naturally I have only given examples which I called to mind and not my entire collected material.

and unfortunately a very frequent one, is DETACHMENT OF THE RETINA.[1]

The facts speak loud and clearly, the theories are debatable, the treatment risky, the cure rare.

The facts are as follows: 1. Under the causes of blindness retinal detachment associated with myopia, occupies an important place, 4% of the cases.[2] The great majority of all detachments depend on high myopia. One has known that ever since the disease was recognized by the ophthalmoscope; indeed one finds it in almost every text-book; but it is essential to have statistics in order to get a better conception of it.

Horstmann found 125 myopes in 145 cases of detachment of the retina. That is but scanty material for a disease which furnishes five cases out of every thousand patients.[3] I should therefore like to give the following statistics from my own material which comprises far more than one thousand examples of this eye-destroying disease, which my assistant, *Dr. May*, has culled from my case-books:

Among the 6,320 patients from 1889–1903, which came to my clinic, there were 180 cases of detachment. To these must be added another 120 cases among the 48,780 old cases during seven years. We have therefore 300 patients suffering from detachment in 338 eyes; 38 cases, or 11% having a detachment on each eye; 142 were affected in the right eye, 119 in the left.

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[1] Also called separation of the retina, or ablatio, amotio and solutio retinæ. Ablatio = taking away, amotio = removal to a distance, solutio = solution = ἀποκόλλησις.

[2] *J. Hirschberg*, Berlin. klin. Wochenschr., 1873, No. 4. According to *Magnus*, 1892, 4.75% of all cases of blindness are due to detachment.

[3] Compare my Klin. Beobachtungen, 1878, Part 3, p. 103. *Horstmann*, 1898, gives 3–4% (Arch. f. Augenh., XXXVI, p. 166).

In 178 cases (203 eyes), i.e., in 60%, myopia was the cause of detachment. But this is only the lowest figure, for among the 62 cases in which the cause of the detachment could not be determined with certainty, a still larger number could be attributed to it. Of the rest, 44 eyes (43 patients), syphilis was the cause in 18 cases.

Myopia under 6 D.	22 patients		23 eyes
Of 6 D–12 D.	82 "		100 "
Over 12 D.	67 "		73 "
Previous operation for myopia in other clinics	14 "		14 "
Total	185 "		210 "

Moreover, in 11 patients (11 eyes) an injury (often only a slight one) was the immediate cause of the detachment.

The clinical appearances of myopic detachment are so characteristic that the experienced surgeon can immediately establish the diagnosis, as soon as the patient has told him his symptoms: the ophthalmoscope merely serves to confirm, or at any rate to define the diagnosis more exactly.[1]

The sight which for a long period since youth, perhaps, has been markedly myopic, suddenly becomes clouded over —either without any obvious cause, or in special cases as the result of a slight injury, or trifling blow. A blackish looking swelling with a smooth rounded top arises from the background from below, or sometimes from above on one or other sides, and hides the corresponding part of the field of view. In a darkened room, when the patient is lying down the swelling appears grey, and lighter than the rest of the visual field, with flashing borders, which are seen in con-

[1] Still I cannot omit the fact that in many cases the disease had already been treated for months without being recognized, as I have repeatedly experienced in my consultation practice

sequence of the mechanical and perhaps chemical irritation of the part distended by the fluid.

In daylight fine type may still be read; of course, when held near the eye, the visual field shows a marked contraction over the area comprised by the elevation—sometimes there is even none at all. In reduced light the eye perceives very little, and the contracted field is clearly perceptible and larger. The light sense in consequence is therefore reduced.

Fiery (or flashing) lights are constantly seen, which surround the corresponding borders of the visual field, scintillating like rockets in circles. These have been supposed to constitute prodromal signs of detachment. This, however, is not the case. They are signs of a disease already established, which for a long time has existed in embryo, so to speak. What the patient calls our attention to is the sudden deterioration, and the rapid increase in the detachment. Long objects appear bent or broken, sometimes fluctuating, like the surface of a shallow brook when the water is lightly ruffled. Light white surfaces appear blue or green.

I must be contented with this sketch of these early appearances, for they are the most important, since by being early recognized, they afford the possibility of immediate rest to the patients, and thus prove of real value to them. On the other hand I have not time to enter into all the other alterations and fluctuations of the subjective appearances which in most cases slowly accompany and destroy, with ever-increasing power, the active functions of the retina.

We must however accentuate the fact that when the fluid which accumulates between the retina and choroid—or more frequently between the retina proper and the pigment epithelial layer—gravitates downward and increases there, it is

invariably the upper and larger half of the visual field which is lost, while the lower part of the field still retains light perception or even a certain degree of discrimination of objects. This accumulation of fluid toward the lower half of the fundus affects the retina more and more by its mechanical and chemical action until finally it brings about degeneration of structure.

If the disease affects both eyes, which unfortunately happens in about 9% of the cases, we notice how the unfortunate patient turns both eyes strongly upward, whenever he tries to see an object straight in front of him, since the upper part of the retina, which is still partly active, is now directed toward the centre of the field and thus sees the objects in front of him.

Even in unfavourable cases traces of sight may remain for months and even for years after a period of rest in the morning when the light is good, while at dusk, toward evening, the eye seems practically blind. But at this period, when it cannot contribute any assistance to the fellow healthy eye, it is markedly affected by subjective light sensations, whereby many—especially sensitive patients—are almost reduced to desperation; in any case the patient is obliged either continually to wear a dark glass over the affected eye, or to block it out altogether.

If we pass from the subjective sensations of the patient to objective tests we can readily recognize by external observation the lengthened form of the diseased eye, but we cannot recognize the detachment in like manner. Only in the very rare cases in which the retina has been forced forward, and become extremely degenerated, is one able to notice under favourable conditions of illumination a grey opacity behind the pupil which is covered with blood-vessels

and then only when the obscuration of the crystalline lens does not at once obstruct the view.

In the similarly incurable and rare cases of acute and painful myopic detachment, accompanied by a totally collapsed globe (which I first described as the counterpart of acute glaucoma), one can make out, with the naked eye, the abrupt steplike appearance of the base of the iris, and the extraordinary depth of the anterior chamber. These form characteristic signs of detachment.

We may here incidentally remark that both local and general anæsthesia are required for the relief of the very obstinate pain.

As a rule the ophthalmoscope must be employed in order to see the detachment properly. But the very slight forms are frequently overlooked, even by experts. The pupil must be dilated by homatropin. By means of a suitable convex lens behind the ophthalmoscope the observer may see the detached retinal vascular trunks which appear to stand out as dark lines just as if painted on glass, while for the rest of the fundus, very different (concave[1]) glasses will be needed to focus up sharply. This image is infinitely more convincing than the so-called parallax.[2] This latter has given rise to many mistakes. The movement of a portion of a retinal vessel on itself by shifting the convex lens in the indirect method does not confirm the diagnosis of de-

[1] Should a concave glass be needed to see the detachment, a much higher concave power will be required to focus up the other parts of the fundus.

[2] This is described by the surgeons as *parallactic displacement.* Cf. my Dictionary of Ophthalmology, p. 76. Apparent movement which by the inverted image causes a near point to travel against a more distant one. [For a popular explanation of parallactic displacement see "Pocket Atlas of the Fundus Oculi," Johnson & Head, p. 142.—*Translator.*]

tachment. This is only effected by the marked displacement of a retinal vessel against a choroidal vessel lying behind it, so that the former is seen first on one side and then on the other. It is worth observing the circumscribed suppression of the red background and the similarly marked faint veiling of the details of the choroid, compared with the clearness of the details in the rest of the fundus.

The slight detachment of the centre of the retina one may see especially clearly by oblique and varying illumination, whereby the portion of the fundus seen appears like the surface of a shallow clear brook when the water is slightly ruffled.

More pronounced detachments are easy to recognize. One sees delicate grey, slightly glittering folds which tremble when the eye moves, and which are covered with vascular branches. The latter appear dark as they are seen partly by transmitted light. The "humpbacked" detachment is also very characteristic, which reaches right up to the disc; but one must use a stronger convex glass to see the summit with the direct method, and with the inverted method the convex lens must be held a corresponding distance from the patient's eye, since the summit stands a considerable distance above the rest of the background. The numerous rents in the detached retina appear as red gaps, inside of which the details of the choroid can be seen.

The older detachments sink downward. With increased magnification by the indirect method it appears like a double window curtain, in the angle of which lies the disc. Ultimately the detachment becomes more and more clouded over by reason of the increasing opacity of the vitreous.

Opacity of the vitreous is hardly ever absent. It proceeds from the front backward. We have only got to look

for it in the right place by varying the convex glass behind the mirror of the ophthalmoscope from + 20 D to the weakest power, and we are bound to find it whether it be punctate, threadlike, or in folds.

In the place of all the much-disputed theories[1] relating to detachment in myopia, I think the following proposition will be satisfactory: *Detachment of the retina is essentially a disease of the vitreous.* The vitreous cannot adapt itself so well to the stretching of the myopic globe as the elastic layers of the sclerotic and choroid, or even the retina itself. The scaffolding of the vitreous gives way, fluid pours into the gaps, and alters the arrangement of the fibres. Contraction of the fibre network, which here and there has become attached to the surrounding retina (though only loosely to the choroid or pigment epithelium), conditions the tearing or lifting off of the retina. Since we now have to deal with the treatment of detachment in myopia, I should like first to put the following question:[2] Can we ever cure a disease which nature can never cure unaided? At all events I should like to emphasize the following: When the disease can cure itself, which is only possible in special cases, *we must observe it very attentively, that we may try to imitate the favourable conditions thereby established and seek to carry them out in an ever-increasing number of cases.*

Detachment of the retina caused by very high myopia passes almost invariably, sooner or later, into blindness of the affected eye. One may "treat" hundreds of such cases

[1] *Leber,* in summoning up the views of *H. Müller, A. v. Graefe, Iwanoff,* as well as his own, gives the following theory: The vitreous shrinks, thereby a rent takes place in the retina, and the vitreous pours through this tear into the space behind the retina.

[2] *J. Hirschberg,* Centralblat. für Augenh., 1891, p. 168. "On Nature's Healing of Detachment in Myopia."

without ever coming across a single exception. In spite of this the disease may occasionally be cured, and this in two ways. The first way is a purely anatomical (or topographic) one. The fluid disappears behind the retina which again adheres, but the eye is blind and remains so. It shows obvious pigment changes, as well as long, and here and there branched and mottled stripes on the background. The light-sensitive rods and cones have perished by reason of the detachment.

In any case the further dissolution of the eye, which we so often observe during the progress of the funnel-shaped detachment of the retina does not take place; we do not get the lens opacity and the secondary retinal inflammation, which would lead the hasty and less experienced surgeon to remove the globe.

The second method of healing is the physiological one. The retina again attaches itself, the eye continues to see, although not quite perfectly. As regards the patient there is an important difference between the two methods—between sight and blindness. As regards the surgeon the difference is only one of degree. The pigment formation is the expression of, although not the exactly corresponding superficial measure of the former detachment.

We must turn our attention to the last-mentioned form if we wish to proceed with the cure of this disease.

I will now give four cases, which are conspicuous by reason of their long-continued observation.

1. A lady, aged thirty-four, came to me in 1891, on account of the headache which her opera-glass caused her. This had an interpupillary distance of 65 mm., whereas the interval between her pupils was only 58 mm.! I found a myopia of 5 D, with normal acuity and normal fundus.

On April 13, 1892, she returned, on account of a blurring which she noticed in the left eye. The eye could in fact still read the finest print (Sn. $1\frac{1}{2}'$ at 6″) but not uninterruptedly; the L. visual field was reduced to 30° on the nasal side, the R. to 50°! The ophthalmoscope showed a blisterlike de-

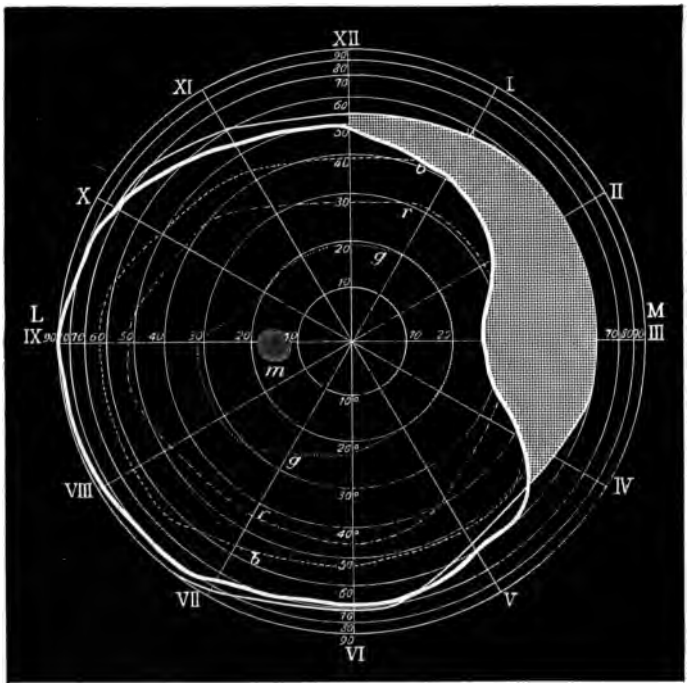

FIG. 5.

tachment on the temporal side which extended right up to the macula. After complete rest the detachment was cured within two days. The retina continued to remain *in situ*. During one of my journeys a little later on, the lady consulted a celebrated colleague of mine, on account of some trifling ailment, and told him that she had had a detach-

ment and had been cured of it, and he laughed out loud, but did not laugh when he saw it with me eleven years later.

On May 28, 1903, she came home accidentally to have her shortsight tested. This had increased to 8.5 D in both eyes. With this glass her vision in either eye = $\frac{5}{7}$. The right field was entirely normal, the left had the form shown in the accompanying figure (Fig. 5). The part of the field which had been recovered had very gradually fallen away, a phenomenon which is only rarely met with, but the rest of the field, and that the most important part, had remained unaltered. There the retina remained perfectly attached, as one was able to prove with absolute certainty after dilating the pupil.

But, in the position of the former detachment we noticed a fine pigmentation of the background which consisted of fine points and short rods, as well as a few mottled and lighter patches, while the extreme periphery was free from them (cf. Fig. 6, p. 68).

I may remark that this picture—which I had already observed and described together with the small bright stripes, has been quite ignored by the text-books[1]—I have invariably found after continued observation in all similar cases. This pigment formation is in nowise the *cause*, but as proved by clinical observation is the *result* of detachment.

2. On June 23, 1880, I was consulted by a lady, aged forty-three, on account of recent dimness of sight of the left eye. She was wearing a glass of − 11 D. R. E. Sn. 1½ at 3″. Visual field good, with the usual changes of myopia in the background. L. E., Sn. IV, at 3″. Visual field fairly good.

[1] See *Uhlhoff*, Bericht. der Oph. Gesellsch. zu Heidelberg, 1903, Wiesbaden, 1904, p. 4.

Recent very pronounced detachment, upward and outward, which comprised about a third of the retina and extended as far as 2 mm. from the disc.

On July 5, 1880, the detachment was completely healed, by rest on her back in a dark room, and iodide of potassium

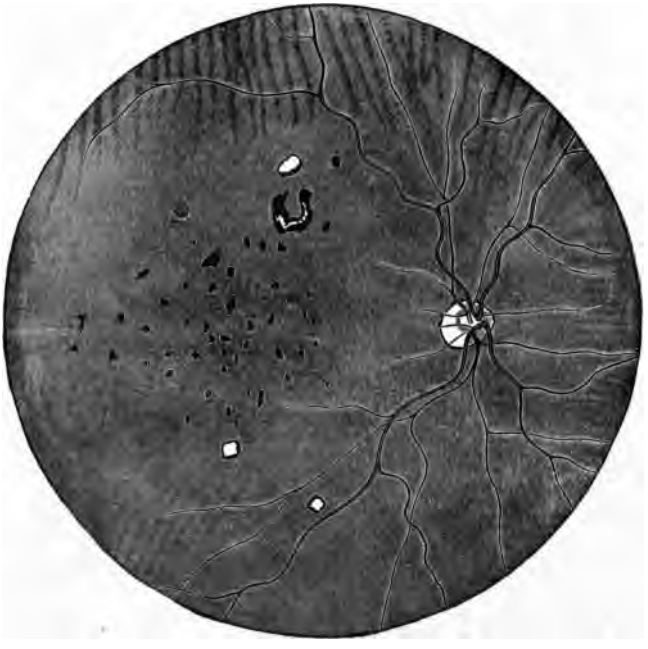

FIG. 6.

internally. On August 22, the lady was looking out of the window during the middle of the day without her dark glasses, and while her menstrual period was coming on. The same evening her left eye became suddenly blind. The next day I found a relapse. The upper half of the left retina was arched forward as far as the disc. The eye could not see the time by the watch. Treatment: Rest on the back

and iodides. On August 28, 1880, the time could be seen. The detachment was very slight. On September 20, the finest type could be read, visual field fairly good. Detachment outward and below (from gravity). On October 22, vision and field were quite equal in the two eyes, also the tension. On dilating the pupil no trace of detachment could be seen.

On June 12, 1903, i.e., after thirteen years, the eye presented precisely the same appearance, Sn. 1½ at 3″. Visual field normal. No trace of detachment seen after dilating the pupil, merely some fine peripheral and central pigment changes.

3. J. W., sixteen years of age, was admitted on November 14, 1888, on account of sudden dimness of vision in the right eye. (Nine years before, i.e., in 1879, I had found a myopia of 8 D. Acuity, ½. In 1883, myopia of 10 D and acuity ½. In 1884, a myopia of 10 D. On March 4, 1888, 12 D, and acuity ⅓, all confirmed by ophthalmoscopic and glass tests). L. E., Sn. 1½′ at 3″. Visual field normal. R. E., Sn. III, at 5″, i.e., diminished myopia by advancement of the retina. Visual field above contracted to 20°. No obscurity in the vitreous. Below detachment-infolds, the boundaries of which remained about 6–7 mm. away from the disc, and bulged forward to about the same distance.

The summit could be brought into focus with a lens of + 3 D—the disc with one of − 20 D. Between the detachment and the disc and on both sides of the macula, one noticed on rotating the mirror (erect method) a hairlike detachment and also an elegant system of wavy lines. T − ½. I ordered a bandage, rest in bed, and pilocarpin injections under the skin. Two days afterward the folds of the detachment had already disappeared. On Novem-

ber 23, 1888, the detachment below and outward; there was still a slight detachment.

On December 4, 1888, the patient was dismissed as cured. Both eyes, Sn. 1½′ at 3½″. Both visual fields 50° upward. Eyes screened for months. On June 9, 1891, same appearances, except below were dots and lines along the borders of the former detachment. On October 6, 1900, i.e., after about twelve years, the patient, now twenty-eight years of age, showed R. E. − 20 D. V = ⅛.[1] Both visual fields normal, except a slight obscuration of the macula region (10°); this was due to a large clear patch at the centre of the fundus (the so-called chorio-retinitis). One observed at the periphery below where the detachment had been, a fine pigmentation of black dots, and tiny target-looking figures. There was no trace of detachment.

4. A man, aged forty-three, came, on April 2, to the Poliklinik. Spots on the cornea and myopia in both eyes since childhood. Since eight days the L. E. has failed. R. E., 2 at 2½″. Visual field good. (Upward, 45°; downward, 60°; outward, 80°; inward, 60°.) L. E., 8′ at 2″. Visual field only good in the inner and lower quadrants (upward, 5°; outward, 10°; downward, 50°; inward, 60°). Extended slight detachment. The patient was treated at his own home by bandaging, rest in bed, diaphoretics (sod. salicyl.). On July 2, 1889, improvement noticed. L. E., Sn. 3½′ at 4″. Visual field extended outside the lower half. On November 28, 1889, visual field was normal and the retina found attached and has been proved to remain so, by careful testing.

Latest tests, October 15, 1903, i.e., over fourteen years

[1] This case affords a clinical demonstration of the fact that just as the myopia increases so the acuity diminishes. 1879, 8 D myopia, V = ½. 1888, 12 D myopia, V = ⅓. 1900, 20 D myopia, V = ⅛.

after the commencement of the detachment. R. E. with −23 D. V = $\frac{1}{12}$. Visual field *nil*, except enlargement of the blind spot area owing to the so-called staph. post. L. E., ditto. Visual field good, but slightly reduced externally up to 60°, with −20 D. V = $\frac{1}{20}$. Sn. 2 at 2″. After the pupil had been dilated, slight lenticular opacity. Vitreous precipitates, ring, and patches of atrophy around the disc. *Scarpa's* prominence at the disc. No trace of detachment, but marked pigment dot deposits over the macula area.

These cases are rather rare. But, as I said in 1891, it would be highly interesting if any eye surgeon would publish four such complete and long-observed observations of cases in which a definite detachment has been shown resulting from very high myopia.[1] Nature appears in these cases to have proved superior to art.[2]

From this it follows that every recent case should be first treated by mild measures (*Friedlich*). Slight cases of detachment can offer years of good vision; I have even observed cases of this kind in both eyes, especially in young persons—and some who have still retained moderate sight after fifteen years. Even those patients possessed with great disturbance of vision and a bulging detachment at first show at least some improvement by the passive treatment, although, as a rule, relapses follow, accompanied by gradual decline of vision.

The passive treatment consists in complete bodily rest. The patient should merely alternate between bed and sofa

[1] I do not wish to refer to cases of spontaneous cure of myopic detachment in which my observations have only extended over a period of from three to five years.

[2] But *Deutschmann*, who, in 1895, published a detailed account of his experiences, declares that for 8% of spontaneous cures he could show 20% of operative ones.

for several weeks, and be waited on hand and foot. The eyes should be completely screened from the light, while iodide of potassium or sodium should be regularly given together with mild sudorifics in hot lemonade or salicylate of soda. I have for a long time abandoned the much-praised subcutaneous injections of pilocarpin.[1] The bandage over the diseased eye does more harm than good, and is badly borne if it is not very soft and lightly applied. On the other hand methodical injections of common salt solution, first in physiological and later in 2% solutions, as I have described above for macula changes, appear to me to be a rational treatment.

If no improvement takes place during the first two or three months one may confidently abandon the treatment. Young ladies have patiently submitted to this rest treatment at their homes for as much as nine months without the progress of the detachment being arrested.

I will not refer to those operative measures (such as injections of iodine into the vitreous) which seem to me rather to provoke than cure the retinal detachment. Nor (with even less excuse) to those methods which not only fail to effect a cure, but even endanger the healthy eye through sympathetic ophthalmia. Such, for example, is *De Wecker's* filtration method by a gold wire loop.

The method of passing a small *Graefe* knife or a lance knife through the sclerotic just beneath the retina in order to evacuate the fluid which maintains the detachment. This is the oldest method first recommended by *J. Sichel*, in 1859, and later on practiced by *Arlt, Wecker, Coccius, v. Graefe,*

[1] ℞ Pilocarpin hydrochl. 0.1, aq. destil. r. c. 5.0. Of this one injection, containing 0.02 of the pilocarpin salt (i.e., 1 c.c. of the solution), should be given for an adult twice a week.

Wolfe, and myself.[1] Recently surgeons have spoken with contempt and quite overlooked the sclerotic puncture, owing to the recommendation of iodine injections which were said to effect a cure in about a fortnight. This statement was contradicted by facts almost as soon as it was uttered.

In any case a complete cure is very unusual. I will add another case to the one previously described which I observed for a whole year before the operation in 1891, and then followed up for a period of over twelve years.[2]

A lady, aged twenty-seven, was admitted on August 22, 1889. She had always been myopic and noticed four weeks before a black half moon in the right eye, downward and inward. Visual field on both sides. Sn. 1½′ at 5″–4½″. Sn. XL at 15′. L. visual field normal. R. F. 40°, inward and below. Above and outward, a very slight detachment of a bluish colour without tear, as if folded back and raised, so that the outer periphery was still attached. Rest, pilocarpin. The restricted field soon became filled out. The pilocarpin treatment was again repeated in November, 1889, and again in January and February, 1890. At that time the raised delicate detachment measured about six disc breadths, outward and above the disc, and six discs in breadth, while the retina was completely attached on the peripheral side of the swelling. Inconsiderable contraction of the field. Vision equals the opposite eye.

On August 22, 1891, the patient again returned with a deterioration in the sight which she had noticed since Christmas, 1890. Sn. 2½ at 4″, slowly and with difficulty. Visual field wanting over the entire lower and inner quadrant as far as the fixation point. The defect extended as far as the

[1] Centralbl. f. Aug., 1877, p. 249; *Knapp-Hirschberg's* Arch. f. Aug., 1879.
[2] Centralbl. f. Aug., 1891, p. 294, and 1902, p. 235.

periphery in wing-shaped processes on the lower and outer and inner and upper segments. Exactly corresponding with this, the bluish elevated, delicate, sharply demarcated detachment began from two disc breadths distance from the disc spreading out as far as the periphery, where a small hemorrhage was to be seen. There was no tear and no pronounced opacity of the vitreous. Tension normal. The patient complained of the great limitation of field, but not of distortion of vision, although the detachment had extended up to the fixation point. The perception of light was lost wherever the retina was raised in the form of a distended bladder.

On September 1, 1901, operation, cocain. The patient sat in the operating chair. My assistant bent her head on her breast, and gently lifted up the lid. The surgeon lifted up the conjunctiva with the forceps as far back as possible behind the equator, pushed the narrow knife deep into the vitreous, rotated it through 90° and withdrew it, enabling one to see the black opening through the coats. He then lifted the ocular conjunctiva sideways away from the scleral opening very slowly and carefully. By so doing this delicate sucking action filled the outer and upper quadrant beneath the bubble of the ocular conjunctiva with the fluid which had existed behind the retina. This fluid, as the fast escaping drops demonstrated, was yellowish and full of threads. Bandage; twelve days rest in bed.

Complete restoration of the retina, confirmed by repeated observation after dilatation of the pupil. The eye read the finest print equally well with the healthy one and had a normal visual field. One could see far above and to the outerside the dazzling white wedge-shaped puncture, made by the cataract knife.

It now appeared to be a hole in the choroid. The scleral wound had healed without a scar. Close behind the white spot are two small hemorrhages, which might have contributed to the sealing up of the wound.

The patient came regularly for observation. There was invariably good vision and complete adhesion of the retina.

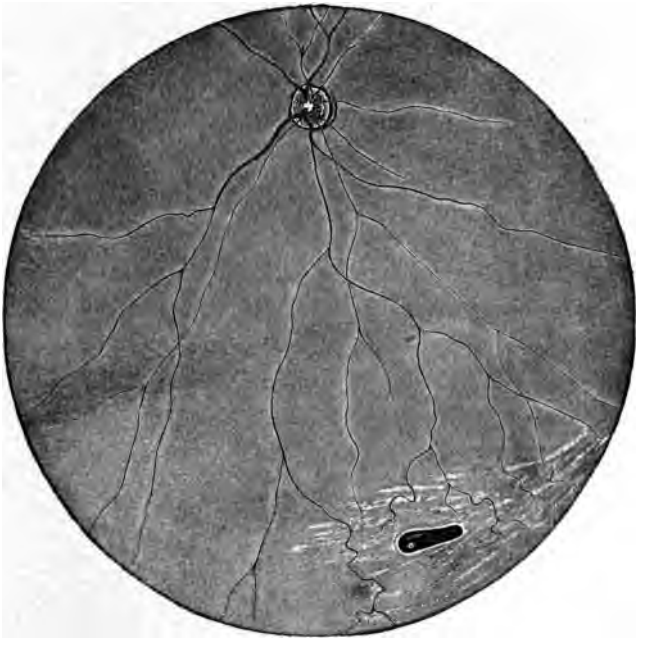

FIG. 7.—Upright Image of the Left Eye.

Ten and a half years after the operation she came, owing to a new detachment on the other left eye. This was in the neighbourhood of a small rent in the retina, which I had noticed nine years before. (See Fig. 7.) After twelve saline injections the detachment appeared to be healed. The visual field appeared as good as such high myopia could

indicate.[1] No detachment could be made out after dilatation.

The fundus changes were very remarkable in the right eye, resulting from the puncture through the sclerotic ten and a half years before. (Fig. 8.)

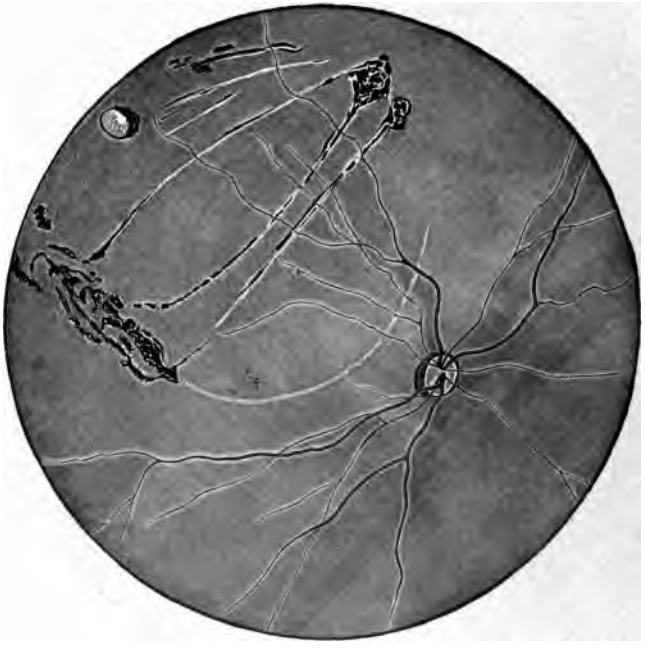

FIG. 8.—Upright Image of the Right Eye.

1. One noticed a light curved line which corresponded to the margin of the firmer detachment.

2. In the field of the old detachment one observed light, and partly pigmented small stripes, together with pigment dots and lines which particularly corresponded to the temporal border of the old detachment.

[1] In the highest myopia the visual field is about 5° or 10° less in all directions than in normal eyes.

3. The puncture scar was surrounded by a semicircular pigmented border.

4. No traces of detachment could be seen. (Cf. Fig. 8.)

The eye read the finest print; the visual field was good,

FIG. 9.—Field of View of the Right Eye.

although, owing to the great extent of the contraction of the field, a small trace of what in the first case of spontaneous cure remained behind. (Cf. Fig. 9.)

After the operation the patient must be watched long and carefully if it is to be successful. That is especially the case

after the operation for cataract which follows the retinal detachment of myopia.[1]

Should myopic detachments have already brought about a cataract, we are obliged to forego the now useless corneal section. Sometimes, however, we cannot afford to oppose the entreaties of the despairing patient, when it is a question of his own eye, and the cataract which rapidly follows on has all of a sudden nearly destroyed the remainder of his sight. In a favourable case one may now hope to recover a fair amount of vision and to keep it for a considerable period, and one is occasionally agreeably surprised when after removing the cataract the absorption of the fluid accumulated behind the retina may have been promoted, and at all events a useful fraction of the vision may be preserved for many years. Such a case, which I was enabled to follow up for twenty-three years consecutively, and which has now reached thirty-three years, and as it is not without interest from many points of view I will briefly narrate here.

1. During the year 1871, a young lady, aged twenty-one, came to me with a high grade myopia. Either eye, with − 20 D, read Sn. LXX at 15′. There was no crescent, and pigment at the pole was scanty.

2. At the commencement of December, 1874, a dark spot appeared in the centre of the right fundus, then curved lines came into view over the upper part of it which at first were colourless, but later on reddish in colour. In obscurity they appeared dark with a bright border. Between the curved lines and the spot was a leash of blood-vessels. (See Fig. 10, which was drawn on March 25, 1878.)

The upper part of the visual field became contracted, and

[1] Cf. Centralbl. f. Aug., March, 1893.

the letters of a page appeared diminished and slanting to the right eye. At dusk the eye saw exceedingly imperfectly. Tests on May 8, 1875, showed L.E., J 2 at 2″. Visual field good. R.E., J 6 at 3¾″. Field contracted above. On the right side the lower half of the retina was detached, very movable and with overhanging folds, so that the patient could see a part of the retinal vessels.

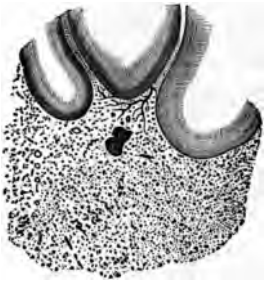

FIG. 10.

In spite of this the patient pursued the prescribed rest treatment at home for nine solid months with an amount of patience only possible to one of the opposite sex, and carried out the medicinal treatment with great intelligence. Notwithstanding this, the detachment increased and became total. On August 21, 1876, cataract followed in the right eye. (Fingers at 1 foot.) The left eye read the finest type at 2″.

3. On February 12, 1880, the patient came with the statement that she now perceived the same phenomena in a less degree with the left eye. R. vision = *nil.* Cataract with detachment behind it. L.E., Sn. 1½ at 2″. Visual field normal. The vitreous is permeated with deeply placed particles. On the nasal side of the pole is a small opacity with hemorrhages. No trace of detachment.

4. On March 4, 1880. Defective vision.

On March 21, eighteen days later, she came to me with detachment at the spot corresponding to the opacity. The hemorrhages are still visible on the detached retina. The inner and upper quadrants of the field are wanting. Sn. 2½ can still be read.

By rest treatment, iodides and the like, the retina fell

back, but no attachment followed. During the month of May, the patient travelled to her home. On September 29, 1880, the lower half of the retina became detached, and the corresponding upper half of the field was wanting. Sn. X, at 2″.

5. On November 8, 1881, the day after a great disturbance, the remaining sight suddenly vanished up to P 2, by reason of cataract and infiltration under the retinal margin.

6. On December 29, 1881, I removed the cataract by *v. Graefe's* method. Healing without inflammation.

On January 16, 1882, counted fingers at 4′. Visual field contracted on the inner side.

7. *The visual power had not only been maintained during the course of the twelve years' observation, but had even improved.* She could walk about alone and go about her business fairly well.

The sight was tested every three months.

On February 5, 1893, with a thin convex glass, she could count fingers at 6 feet and read Sn. XII, with + 12 D at 5″. Visual field, upward, 40°; downward, 50°; inward, 35°; outward, 40°. Slight capsule opacity. Disc visible, no detachment visible. Tension normal.

So it went on up to May 4, 1889, i.e., eighteen years after the extraction of the cataract, then the patient was knocked over by a wagon and since then she has seen worse. Fingers only counted at 1 metre, and further decrease of vision followed very slowly.

The latest phase of operative treatment for myopic detachment can be found in the recently published *Bericht der Heidelberger Ophthalm. Versammlung*, in 1903.

A. v. Graefe had recommended the meridional section of the detached retina as far back as 1875, for he had observed

an opportune reattachment by spontaneous rupture of this membrane, although recurrences were not wanting.

Lately *Deutschmann*[1] has recommended the extensive division of the detached retina and the injection or insertion of rabbits' vitreous. But soon, after a remarkable recovery from the harmless treatment (which is usually without result), one has almost always to resort to the simple puncture of the retina, which may be frequently repeated at sufficiently long intervals. If it remains useless then, under special circumstances, rabbits' vitreous may be injected. It thus happens that eyes may be saved which have defied the more simple treatment. The clearing up of the vitreous often takes months to effect.

Great patience is requisite both on the patient's side as well as on the part of the surgeon in order to arrive at success.

The division of the detached retina was described by Professor *Deutschmann* at the Heidelberg Congress, in 1903,[1] and he showed seven cases which he had cured, at the meeting. His description is given in the following words:

A bayonet-shaped double-edged linear knife (used for greater convenience in handling) is pushed tangentially through the front part of the margin of the conjunctival fold facing the cornea (the bulb being turned upward as far as possible), and then quickly passed through the globe, in the same way as one performs a flap extraction section, so as to make the counterpuncture diametrically opposite. In making the latter one must avoid dividing the conjunctiva. The knife having divided the retina is now withdrawn along the

[1] *Deutschmann's* Beiträge, 1895 and 1899, XX and XL. Heft LIX, January, 1904, has just been placed in my hands during the correction of the proofs. Cf. Heidelb. Bericht für 1903, p. 249 (Wiesbaden, 1904).

same path, and slightly rotated on passing through the opening.

In Heidelberg, in 1903, *Dr. L. Müller* was also present, who gave his own method in opposition to that of *Deutschmann.*

Dr. Müller operates in the following way, the patient being under deep narcosis: The first part of the operation consists in temporary resection of the outer wall of the orbit by *Krönlein's* method, then the orbital periosteum is vertically divided, the outer rectus muscle exposed. Two ligatures are tied round the belly of the muscle and the latter divided between it. The anterior third of the inferior oblique muscle is then detached from its origin so as to allow of more room. One now excises a piece of the sclerotic, 8 to 10 mm. broad and 20 mm. long, extending along the outer side of the elongated globe. The anterior border of the piece to be removed lies 1 to 2 mm. behind the insertion of the external rectus, the posterior border at the equator. About five stitches made of permanent (insoluble) silk are inserted through the edges of the sclerotic wound. All this must be done (and in this lies the difficulty of the operation) without injuring the choroid in the slightest degree and without allowing any of the contents of the globe to escape. One now passes a fine knife through the choroid close to the lower angle of the wound, and allows just as much of the subretinal fluid to escape through the narrow opening between the stitches as the reduced ocular coat will permit of.

Dr. Müller has performed the operation on seven patients and has exhibited a case of this kind which he has cured, before the Vienna Medical Society. The idea is to perform this operation in cases of high progressive myopia; only in

this case before the threads are tied one must puncture the globe in front of the ora so as to reduce the volume of the contents. Whether a sufficient number of surgeons and patients will be found to have confidence in this rather considerable encroachment on the eye, lies in the lap of the future. Up to the present it has not been possible to pronounce judgment on such an insufficient number of cases, and observed over such a short period of time.

Perhaps bearing in mind the large number of complications of high myopia, especially as we are only able to meet them with a very few active remedies, I will not say we are discouraged although we are depressed; but bearing this in mind you may be inclined to ask: Why don't you lead us against this stronghold of the enemy?

What kind of remedy exists to neutralize this myopia as such? What means have we to prevent its origin—or at any rate to stop its progress?

At that time one could only express the wish to remove the condition of high degrees of myopia, since one did not even know to what it was due. So long as one imagined that high myopia depended on excessive curvature of the cornea, and that the increased refractive power of the first and most important part of the double objective lens depended on it, one made the very pardonable attempt to diminish the supposed excess of curvature by a pressure bandage—an attempt which is not only useless but must be directly injurious, and furthermore, owing to the length of this prominent myopic eye, it could not be borne. It was just as faulty to fight against the mythical overcurvature of the cornea by drawing off the aqueous by means of repeated punctures of the cornea (paracentesis).

Other investigators made just as bad a mistake by assuming

that excessive curvature of the crystalline lens was the cause of the myopia, and tortured their patients by the so-called atropin cure, which they kept up for weeks and months, i.e., by the instillation of a ½ or 1% solution of atropin daily or oftener.

This treatment, which was recommended by *Professor Schiess*,[1] in Basle, in 1872, is at all events free from danger, at least in the majority of cases, that is to say in the case of children and young patients. But the hoped-for or more often imagined benefit did not take place. Any one who tests carefully will find that the same degree of myopia remains before and after the atropin treatment. Spasm of accommodation of the myope is commonly only a mistaken diagnosis of the surgeon, who has failed to correct the accompanying astigmatism.

In former days I carried out the so highly praised atropin treatment sufficiently often to be convinced the theory was wrong. It renders neither more nor less benefit than rest of the eyes, which we are accustomed to order in any case for young myopes as well as for rapid increase of myopia.

The transition to the correct doctrine of extension was formed by the half correct one, viz., the stretching of the eye by reason of the excess of power of its external muscles. At first it was the oblique muscles, especially the superior oblique,[2] which was held to be the culprit.

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[1] Contribution to the Therapy of Myopia, Basle, 1872. If we select the first six cases which have been rather longer observed, we find the "definite improvement" for the two eyes, R. $\frac{1}{72}''$, L. $\frac{1}{93}''$; R. $\frac{1}{70}$, L. $\frac{1}{50}$; R. 0, L. 0; R. $\frac{1}{120}''$, L. $\frac{1}{120}$; R. $\frac{1}{20}''$, L. $\frac{1}{18}''$; R. $\frac{1}{18}$, L. $\frac{1}{36}$. But in the seventh case in which high myopia existed R. $\frac{1}{3}''$, L. $\frac{1}{4}$, the definite improvement of both sides was *nil.*

[2] *Stilling*, even at the present day, blames this last muscle without, however, recommending its division.

Eye surgeons, on the advice of *Philips*,[1] divided the superior oblique through the "zeal of ignorance," of which we can only think with a shudder, and with surprise at the devotional courage of the patients. But the place of dividing both the inner and outer recti which we owe to *Jules Guerin*[2] and the celebrated *Bonnet*[3] was very little in advance, a method which has been adopted in our day by *Gerloff*.[4]

A more reasonable plan was the division of one of the externi, viz., that of the more myopic eye. This operation was first recommended by *A. v. Graefe* to counteract the so-called muscular asthenopia or insufficiency of the internal recti, or the marked outward squint of the myope, for which even to-day it has not lost a certain, although very limited, value. Even this operation alone ought to arrest the progress of myopia.

But that is not the case. A large number of patients have come under my hands—I myself have not contributed to their number—ten, twenty, even thirty years after the performance of the tenotomy of the rectus externus. I have practically never been able to prove any arrest of the progress of myopia by this method—although I have frequently seen homonymous diplopia brought about by muscular overcorrection, i.e., by artificially induced internal squint, which in some cases has lasted for years.

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[1] Etiologie du Strabisme, Paris, 1843.

[2] Traité des sections tendineuses, 1841.

[3] Bericht der Heidelberger Augenärztl. Versammlung, 1892. Centbl. f. Augenh., 1892, p. 392.

[4] Archiv f. Aug., III, 1, 313, 1857; VIII, 2, 314, 1862, and particularly *Zehender's* Monatsbl., 1869, p. 224. "Ueber die Operation des dynam. Auswärtsschielens." Out of 80 cases of progressive myopia only 6 continued to advance to a higher degree, while four continued slowly progressive.

Can one stop the axial stretching of a highly myopic eye by an operation? The question reminds us of the pretty fairy tale of the God of Healing, Æsculapius, which has been given to us in the rediscovered marble tablets at Epidaurus. One cannot afford to trifle with the actual seat of the "staphyloma posticum" at the posterior pole of the eye, both on account of its inaccessible seat, and on its importance, since it includes the best part of the irreplaceable and costly retina.

And yet a strip of tissue, 20 mm. long and 8–10 mm. wide, has been dissected out of the equatorial region of the sclerotic, under an anæsthetic, after *Krönlein's* temporary resection of the zygoma had been performed, in order to shorten the elongated globe—and this plan has been actually announced in our time as glad tidings to an amazed medical world (!!). Will it succeed?

But what is the position of this myopia operation? Was it not only a few years ago that we read in the *Gartenlaube Magazine*, that its discoverer, *Vincenz Fukala*, had been declared the equal of the greatest benefactors of the human sight, to a *v. Helmholtz* or to an *Albrecht v. Graefe?*

Such exaggerations damage the very soul of things, and the correct judgment of the possible value of an operation.

The fact that a strongly myopic eye when it is afflicted by cataract, and then happily freed from it by operation, can enjoy a good distant vision without the customary thick cataract glasses—in a word has become normal sighted, or as surgeons would express it, has become emmetropic—was already an operation in vogue by various surgeons and oculists during the eighteenth century [1]—*Woodhouse*, 1707, *Boerhaave*, 1708, *A. v. Haller*, 1755—and they brought the idea

[1] See *C. Hess*, a. a. O., p. 329, and my Geschichte d. Augenh., § 384.

forward that highly myopic eyes by removal of the clear lens, whether by extraction or needling, can be converted into a farseeing one. The following names of the last third of the eighteenth century and first half of the nineteenth deserve mention:

Higgs, 1745; *Haller*, 1763; *Janin*, 1772; *Demonceaux*, 1776; *Richter*, 1790; *Beer*, 1817; *Weller*, 1822; *Benedict*, 1822–1825; *Radius*, 1825; *Sperino*, 1841.

This idea repeatedly came to a successful issue.

In 1858, *A. Weber*, who still remains among us, and *Mooren*, who has only lately been taken from us, reported at Heidelberg on their partly successful and partly unfavourable reports of removal of the transparent lens in the myopic eye. But they experienced emphatic contradiction from *A. v. Graefe* and *Donders*. In consequence of this, the operation was only carried out in isolated cases during the next twenty-five years, and with the exception of *Weber* and *Mooren*, was only performed by *Coppez* (1867), *Wicherkiewicz* (1881), and *Smith*, in Chicago (1881), while *Mauthner* (1876) warmly supported it from a theoretical aspect.

Donders, in his celebrated work on "Refraction and Accommodation" (1866, p. 351) designates this operation as a "punishable presumption." But then he added that even in the most favourable case no real advantage can be obtained; that on the one hand the staphyloma posticum remained just as threatening, while on the other hand the power of accommodation was sacrificed, the acute thinking scientist at any rate erred in respect to the second point, viz., through overvaluing the loss of accommodation.

But what service has *Fukala*[1] rendered? He has, with

[1] Operative Behandlung der höchstgradigen Kurzichtigkeit durch Aphakie, A. f. O., XXXVI, 2, p. 330, 1890.

great daring, popularized the operation which had rarely been done up till then. Many myopes have to thank him for better sight—many for loss of sight. His procedure was only mediocre. At the International Congress at Moscow, where he was the reporter for myopia operations, I was unable to get him to put down any statistics of his results.[1]

Others have improved upon the method and to some degree freed it from the serious dangers attached to it. *But even to-day this myopia operation belongs to the most responsible operations of the ophthalmic surgeon.* It is only permissible in the highest degrees of myopia (over 15 D); and even among these cases only a small number are suitable. The surgeon who will form an opinion regarding the suitability and the value of the operation, must in the first place seek to gain a theoretical understanding of it, and then establish the fundamental proposition, viz., Under what circumstances may the removal of a clear crystalline lens convert a highly myopic eye into one approximately emmetropic?

Let us first consider our Fig. 1, *A* (see p. 8). A bundle of rays proceeding from a very distant point of light falls on the cornea of a normal eye as a parallel beam, and by the refraction of the front surface of the cornea is made so far convergent that the rays will unite to form an image about 30 mm. behind the cornea, i.e., about 6 mm. behind the retina. If the retina of an aphakic eye were placed at this spot it would receive a clear image of a distant object, without any glass, i.e., the eye would act like an emmetropic one. We see, accordingly, that an axially elongated highly myopic eye must be about 30 mm. in length, in order that it can see objects at a distance after removal of the lens. Such an

[1] Twelfth International Congress of Medicine at Moscow, Section XI, Moscow, 1898, p. 173.

axially elongated eye, deprived of its crystalline lens, corresponds to a myopia of 18 D, and the myopia must be equal to between 18 D and 20 D, in order that it should be approximately emmetropic after the operation.

If the myopia were considerably more, for example 30 D, the eye would still be myopic after the operation, which is unavoidable. If, on the other hand, the myopia was markedly less (e.g., 10 D), then a hyperopia of about 5 D would remain after removal of the lens, which one must unconditionally get rid of. Then the operated myopic eye would be

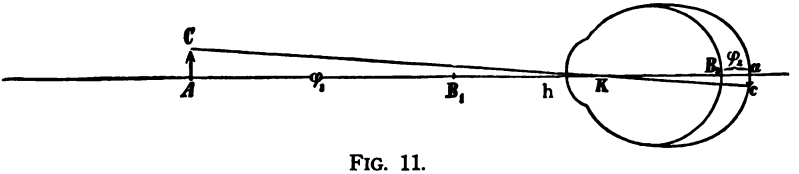

FIG. 11.

ϕ_1 = distance of object from the anterior focus B_1 of the eye = AB_1 ϕ_2 = difference in position of the posterior focus for a near object and for one at infinity = $\phi_1 = B_2a$. F_1 = anterior focal distance of the eye = AB_1 = 15 mm. F_2 = posterior focal distance = hB_2 approx. = 20 mm.

entirely compensated without glasses for near objects, but insufficiently for distant vision. At any rate, it would never be even approximately emmetropic, since for distant vision it would then require strong convex glasses (+ 5 D), and consequently for near work (on account of the absence of accommodation), still stronger ones (+ 10 D) would be required. Hence a myope of 10 D would be much better off if his eye remained unoperated on, and wore a glass of about 8 D, with which he could see distant objects fairly well, and at the same time it would suffice for near objects, or perhaps with one a little weaker. Fifteen diopters represent the boundary line at which one can advise the operation, especially in children.

The difference (U) between the original refraction (R_1) and the refraction after removal of the lens (R_2).

$$U = R_1 - R_2$$

should be understood by those who intend to perform this operation. It was not an uncommon mistake of many specialists to consider the large U as a constant. By its nature U is a variable. It increases with the dioptric number of the original refractive condition (R_1) even when we suppose, for the sake of simplicity, that all myopic eyes possess exactly the same refractive indices as the average emmetropic eye, so that the increase of myopia would be conditioned constantly and entirely by the length of the visual axis.

On this last supposition, which is approximately correct, each millimetre of increase in length of the visual axis in a lens-holding eye corresponds to an increase in myopia of 3 D, but in the case of an aphakic eye to only one of 1.5 D.[1]

In order to prove this we can make use of a reduced schematic eye, which has only one refracting surface, but gives the same sized image as the normal eye. Let hB_2 (Fig. 11) be the axis of the schematic emmetropic eye. This is adjusted for parallel rays and has an anterior focal distance of 15 mm. and a posterior distance of 20 mm. reckoned from *h*. Suppose the object Ac be placed at a (near) point distance in front of B_1 so that AB_1 is $= \varphi_1$ which is the anterior focus of the reduced eye, then the refracting apparatus of the latter will project an image *ac* which lies at a distance, $B_2 a = \varphi_2$ behind the posterior focus, B_2, of the eye.

If *ac* falls on the retina we have a myopic eye whose axis

[1] See my communication in the Centralb. f. Augenh., March, 1897.

ha is longer by $B_2a = \varphi_2$ than hB_2 the axis of the reduced eye. Then

$$\varphi_1 \varphi_2 = F_1 F_2 = 15 \times 20 = 300.$$

and $\varphi_1 = \frac{300}{\varphi_2}$. If we put $\varphi_2 = 1$ mm., then

$$\varphi_1 = \frac{300}{1} = 30 \text{ cm. or } 3 \text{ D.}$$

If we put $\varphi_2 = 2$ mm., then

$$\varphi_1 = \frac{300}{2} = 15 \text{ cm., or } 6 \text{ D.}$$

If $\varphi_2 = 3$ mm., then

$$\varphi_1 = \frac{300}{3} = 10 \text{ cm., or } 10 \text{ D.}$$

[Hence for every increase of the axis of 1 mm. the eye will show an increase of myopia of about 3 D for small increases in length.

If we put $\varphi_2 = -1$ mm., then $\varphi_1 = \frac{300}{-1} = -300$, or 30 cm. $= 1$ D. So for every shortening of the axis of 1 mm. the eye will show a hyperopia of about 1 D for small decreases in length.—*Translator.*]

When the crystalline lens has been removed in a normal eye the anterior focal distance F_1 is equal to 23 mm. and the posterior one F_2 to 30.8 mm. These are, in fact, the focal distances of the corneal surfaces. Hence for the aphakic normal eye we have:

$$F_1 F_2 = 23 \times 30.8 = 708.$$

So that in the aphakic normal eye the constant $F_1 F_2$ is more than twice as large as in the reduced normal eye.

In the case of the normal aphakic eye, $\varphi_1 \varphi_2$ will therefore = 708.

If we put $\varphi_2 = -1$ mm.,

then $\varphi_1 = -708$ (mm.) and $\frac{1000}{708} = 1.4$ D.

The increase in hyperopia of 1.4 D (i.e., roughly 1.5 D) corresponds to the shortening of the axis by 1 mm. A myopic increase of 1.5 D corresponds to an increase of the axis of the aphakic eye of 1 mm.

The higher the original myopia the greater is the loss of efficiency of the axial elongation for the eye when rendered aphakic, and the larger in consequence is the difference U [i.e., the difference between the refractive power of the eye —when possessed of, and that when deprived of, the crystalline lens.—*Translator*]. It is just like changing our money for foreign gold, the larger the sum the greater will be the amount lost in the exchange.

We are now in a position to construct the following table:

Length of Visual Axis S	Refractive Power of the Lenticular Eye, R_1	Refractive Power of the Aphakic Eye, R_2	Difference between R_1 and R_2, U
24	Em	H 10 D	10 D
25	M 3 D	8.5 D	11.5 D
26	6 D	7 D	13 D
27	9 D	5.5 D	14.5 D
28	12 D	4 D	16 D
29	15 D	2.5 D	17.5 D
30	18 D	1 D	19 D
31	21 D	Nearly E	21 D
32	24 D	1.5 D	22.5 D
33	27 D	3 D	24 D
34	30 D	4.5 D	25.5 D

The best way is to reckon R_2 (i.e., the condition of the eye after extraction of the lens) mentally. We find the value of R_2 (x) for the eye to be operated on, which has a myopia of xD, by subtracting from the R_2 of the emme-

tropic aphakic eye (i.e., H = 10 D) half of the dioptric value of the myopia *Mx* of the eye to be operated on

$$\text{or } R_2\,(x) = \left(+10 - \frac{Mx}{2} \right) \text{D}.$$

Example.—The patient's eye to be operated on shows a myopia of 20 D, hence the refraction R_2 after removal of the crystalline will be expressed by

$$R_2 = +10\text{ D} - \frac{M\,(x\text{D})}{2} = 10 - 10 = 0 = \text{E}.$$

So much for the theory, which perhaps some of you who are mathematicians had a difficulty in solving notwithstanding its surprising simplicity. At any rate it seems to me indispensable.

We now arrive at the practice and results of this treatment. I cannot compare this operation for myopia as many of my colleagues have done to the one performed for grey and green cataract. Enormously more is gained in the latter case than in the operation for myopia—at least that is my opinion. It was by no means new to me at the time. It was only later, when *Fukala* contended against the mistrust of the operation, that the results appeared too bad.

The results of the operation on a seeing eye in young persons, were worse than the operation on a cataractous eye in an old subject. More cases of infection were published. But this danger was the one I least dreaded. Up to that time I had operated on 200 laminæ cataracts in young persons, in which the steps are the same as those employed for myopia, and I have never once lost an eye; not even at an earlier period when our treatment of wounds was unfortunately still very defective.

By far the worst danger is that of detachment of the retina afterward. An excellent and careful operator like

Sattler found it in 4 cases out of 65—almost 7%.[1] And this is only a low estimate, since the time of observation has still been too short. I know, too, that other admirable operators have experienced detachment in 10% of their cases. That represented the percentage of losses after flap extraction a hundred years ago! I have operated on a large number of excessively shortsighted eyes for cataract, and, as already mentioned, I have never once seen a detachment follow. So that, according to my view, the detachment has depended upon the faulty method of operating, which one is accustomed to see in myopic eyes, especially from the numerous discissions extending right into the vitreous. For the idea that the detachment which follows the operation for myopia does not bear any casual relation to the latter, or that it has occurred in spite of the operation in certain cases, is too little founded on scientific facts and too unpractical to be accepted by a thoughtful surgeon.[2] Not only the time of the prolapse and the exceptional gravity of the disease which after a brief interval almost invariably lead to complete blindness in the eye concerned, but also the anatomical relations, so far as they could be ascertained during the clinical observations, stamped these detachments as a direct and active consequence of the operation.

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[1] I have described 33 consecutive cases operated on by me in the Berliner klin. Woch. for 1899, No. 31. In one case of high myopia, hemorrhage and later on detachment followed a long interval of time after the operation.

[2] Surgeons have compared detachment in non-operated with operated myopic eyes. Some found the proportion the same. But the time under observation has not been sufficient for comparison. The form of detachment after an operation is a special one. It causes the entire sight to disappear in a shorter time. *Froehlich* found detachment in 1.25% of the cases in non-operated eyes, but after operations 3.3%. *Fischer* even 0.5% as against 5.5%.

An example will illustrate this:

On April 20, 1903, a youth, aged nineteen, informed me that he saw equally well with either eye, only the left eye was somewhat more myopic. He had been operated on, October 20, 1899, on the left eye for myopia by needling, and three days later the lens was extracted. After the operation he saw no better than before, but after some time he saw much worse. In May, 1903, he was again operated on by needling. At first he saw somewhat better, but in September, 1903, he suddenly became blind in the right eye.

I found that the right vision with $-$ 14 D $= \frac{5}{35}$. Visual field markedly shrunken, as occurs in the highest grade of myopia, and the usual changes at the disc and macula (genuine staphyloma). The left eye was blind. Tension reduced. Cornea clear on the whole. The iris was overgrown by a short oblique scar of a corneal section, and covered with new formative blood-vessels. The pupil was narrow and irregular, the lateral half free, the centre opaque and filled out by capsule and connective tissue; the latter could be traced as a vascular coulisse far into the vitreous. The fundus was no longer visible.

No experienced surgeon could deny that in this case the retinal detachment resulted in consequence of the operative splitting of the vitreous. The unfortunate man learned basket-weaving in a blind asylum, and soon after applied for a testimonial of blindness. Immediately after that he again returned with hemorrhages and pain in the blind eye and marked changes in the other.

I removed the left degenerated eye. The pathological examination confirmed my view. Connective tissue spread from the corneal scar into the pupil and into the vitreous extending as far as the funnel-shaped detachment of the

retina. This last was in consequence of the operation. It is plain we have to improve on methods and above all simplify them, and reduce the number of operations for the single eye, not five or seven but one or two and almost three operations and also not to allow them to follow one another too quickly.

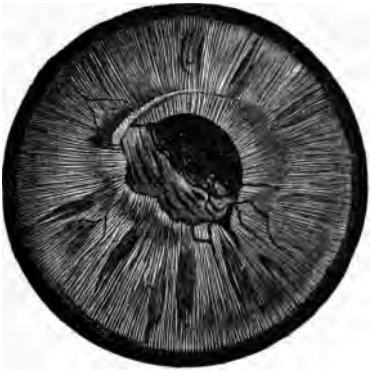

FIG. 12.

I invariably seek to preserve the circular pupil and to do it by a single operation in the case of children and by two in adults.

In the case of children after dilating the pupil I make a moderate cut into the capsule and the superficial layers of the lens. By moderate instillation of atropin, the lens should be completely dissolved within two to three months. This method was easy after the lamellar cataract. Too small a discission caused some inflammation, without leading to complete solution of the lens matter. If, however, in spite of this, great swelling and tension should arise, one must naturally remove the lens mass by means of a lance-shaped knife passed through the corneal margin.

In the case of adults I prefer to needle, and four or five days after, before the tension rises, I make a corneal flap through which the lens emerges comfortably and completely. Moreover, in the case of quiet patients one may perform the flap section without a previous discission. At the present day a roomy incision and as far as possible a complete evacuation of the lens is laid down as being of the chief importance in all standard works on this subject.

The operation recommended by *Fukala*,[1] by which the swollen lens is evacuated by a lance-knife incision in grown-up people as well, is surrounded by great dangers, one veers between the Scylla of loss of vitreous and the Charybdis of tension. This last makes the third danger and demands many an after-operation in order to save the eye from destruction.

The fourth danger is hemorrhage of the retina which often shows itself months or even years after the operation, and chiefly occurs at the centre of the fundus [i.e., the macula region.—*Translator*]. It greatly reduces the power of vision, but does not entirely destroy it.

Should very great retinal changes be present, one is obliged to abandon the operation; but in the case of moderate ones, it may be allowed. But it is impossible to guarantee that the condition will remain unchanged. The process of stretching of the fundus is not stopped by removal of the lens. *Donders* presumed that would be the case, and experience has confirmed it.

I had a case of a child, aged eight, in 1895, who had − 16 D and V = $\frac{1}{1\frac{1}{2}}$ in the R. E. and − 13 D, V = $\frac{1}{1\frac{1}{2}}$ in the left one. The R. E. was operated on for myopia and the healing was ideal. On June 18 of the same year, the R. E. with + 3 D had V = $\frac{5}{2\frac{5}{0}}$, and the left with − 13 D, V = $\frac{1}{1\frac{1}{2}}$. On March 13, 1902, i.e., nearly seven years later, the eye had become emmetropic. Without any glass, V = $\frac{5}{1\frac{5}{0}}$. L. E. with − 18 D, V = $\frac{5}{2\frac{5}{0}}$. Then in seven years, by careful attention to the eyes, the R. E. which was operated on had increased its refraction by 3 D, the left unoperated one by 5 D. The progressive elongation of the axis was demonstrated in both eyes and nearly the same in each.

[1] Treatment of Myopia, 1896, p. 50.

This is not an isolated case, neither in my experience nor in the literature—although it is not strictly according to the rule.[1] Moreover the last word has by no means been said on the subject. We must wait until about twenty years have elapsed since the myopia operation had been performed.

I am very cautious regarding the choice of suitable cases for operation, and in common with first class operators like *Panas*, *Knapp*, and *Fuchs* have always been exceedingly conservative. Even the excessive delight of educated and sensible patients over their successful cure, which they have told both verbally and by letter, has in no degree diminished my careful consideration for each consecutive case. After certain representatives of science had played to the gallery by discussing the myopia operation in the political papers and magazines, crowds of people who imagined that they were suitable subjects for the operation flocked from Berlin and every German district and even from foreign parts. But only a few of them were selected. Those who were told by medical men that they must allow the detached retina to settle into position without any operation[2] were comforted, and the groundless character of these admonitions was pointed out, those again who were already suffering from detachment, or a defect of vision which almost amounted to blindness, were absolutely excluded from operation, as well as all those who had serious diseases either near the eye or in other parts of the body; and finally those whose myopia

[1] That is to say, anatomically speaking the R. E. shows 3 D = 2 mm. elongation. L. E., 5 D = 1.6 mm. elongation, as I pointed out, respecting the difference between the aphakic and lens-holding eye.

[2] This view has been supported by *Vacher*, who independently of *Fukala*, and soon after him recommended the removal of the lens in high degrees of myopia. Compare his communication to the Medical Society of Paris in 1891. "Traitement de la myopie progressive et prophylaxie du décollement de la retine par l'extraction du crystallin transparent."

had not reached the degree suitable for the operation,[1] and were in the position to be fitted with suitable glasses.

I have only selected such patients for operation, which in the first place were quite helpless without it. Children who could scarcely find their way to school alone, and in the school could make no progress, female teachers, working men and women who were unable to earn a living, a practitioner who could not carry on his profession,[2] in short, men who, owing to their excessive shortsight were unable to enjoy life, and who on the other hand gave me a guarantee,[3] that I could take them under my care until they were completely cured. I take it for granted that the operation is not free from danger. As a matter of principle I only operate on one eye—the worse one.

From the close of 1893 to the commencement of 1901,[4] I have relieved twenty-four persons in all from high myopia, the majority of them children, but also young persons as well as a few adults below forty. This forms a very small proportion of operations compared with the enormous number of high myopes who sought my aid during the seven years. It must have exceeded 3,000 cases of myopia of 6 D

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[1] I have seen children of good families with only 6 D of myopia, in whom the operation had been advised, but had the good fortune, owing to my disapproval, not to be operated on. I have observed a person of sixteen years of age, whose left eye had been operated on five times for myopia, and who required + 6 D in order to gain an acuity of $\frac{5}{3}$ for distance, while with the unoperated eye he got $\frac{5}{7}$ of acuity with − 7 D! The myopia which had existed before the operation in the left eye was only 8 D!!

[2] To-day, six years after the operation, he can not only pursue his vocation, but is able even to make investigations.

[3] I met with a tramp once, who had had one eye operated on for myopia in South Germany, the fellow one in Middle Germany, and in North Germany the first one had already become blind by retinal detachment.

[4] Since then none! The more bad results I met with among the operations of my colleagues, the more did my hesitation increase.

and over, among which were hundreds of cases of very high myopia of 16 D and over.

Owing to this careful selection of cases the results on the whole were satisfactory. I had only to regret one case of detachment, and that was in the early times, when the improved "technik" had not been arrived at. In two cases the vision declined, owing to hemorrhage into the retina and vitreous. The other cases were all benefited or would be as soon as the fine secondary cataract was divided.

Gentlemen: I naturally feel it my duty to support the statements I have laid down by my own observations, and shall therefore, as shortly as possible, set down the visual acuity recovered in twenty-four cases operated on by me, in order to submit a certain amount of clinical material on which you may base your judgment on the operation.

CASE BEFORE OPERATION.

No.	Name.	Age.	Date.	Result.
1	A. H.	7	1893	$-15\ \mathrm{D} = \frac{20'}{c}$ both.
2	F. M.	30	1895	R. -20 D L. -23. Finger 8′.
3	B. M.	8	1895	R. $-20\ \mathrm{D} = \frac{1}{12}$.
4	B. M.	25	1895	R. and L. $-20\ \mathrm{D} = \frac{5}{60}$.
5	S. D.	21	1896	R. $-18\ \mathrm{D} = \frac{5}{60}$ L. $= \frac{5}{20}$.
6	Dr. X.	28	1896	R. $-20\ \mathrm{D} = \frac{5}{20}$ L. $-17\ \mathrm{D} = \frac{5}{15}$.
7	W. K.	13	1896	R. $-16\ \mathrm{D} = \frac{5}{20}$ L. $-16\ \mathrm{D} = \frac{5}{20}$.
8	A. T.	39	1895	R. $-26\ \mathrm{D} = \frac{5}{30}$ L. $\frac{5}{60}$.
9	C. F.	11	1897	R. $-14\ \mathrm{D} = \frac{5}{20}$ L. $-16\ \mathrm{D} = \frac{5}{20}$.
10	M. D.	10	1897	R. $-14\ \mathrm{D} = \frac{5}{30}$ L. $-16\ \mathrm{D} = \frac{5}{60}$.
11	H. M.	22	1897	R. $-27\ \mathrm{D} = \frac{5}{25}$ L. $-22\ \mathrm{D} = \frac{5}{25}$.
12	C. G.	31	1897	R. -16 D L. $-14\ \mathrm{D} = \frac{15}{30}$.
13	J. S.	36	1897	R. -18 D L. $-14\ \mathrm{D} = \frac{5}{20}$.
14	v. H.	15	1897	R. $-16\ \mathrm{D} = \frac{5}{15}$ L. 15 D $= \frac{5}{60}$.
15	C. H.	18	1897	R. and L. $-23\ \mathrm{D} = \frac{5}{30}$.
16	L. L.	14	1897	R. $-20\ \mathrm{D} = \frac{5}{15}$ L. $-9\ \mathrm{D} = \frac{5}{9}$.
17	M. R.	20	1898	R. $-20\ \mathrm{D} = \frac{5}{15}$ L. $-13\ \mathrm{D} = \frac{5}{15}$.
18	R. S.	26	1898	R. $-19\ \mathrm{D} = \frac{5}{15}$ L. $-18\ \mathrm{D} = \frac{5}{20}$.
19	G. S.	20	1899	L. -18 D (Fig. 12) R. -13 D.
20	F. M.	7	1899	R. and L. $-20\ \mathrm{D} = \frac{5}{35}$.
21	R. S.	39	1899	L. $-18\ \mathrm{D} = \frac{5}{35}$ R -16 D.
22	H. P.	17	1900	-16 D R. and L. $= \frac{5}{35}$.
23	G. H.	12	1901	-16 D R. and L. $= \frac{5}{20}$.
24	A. D.	10	1901	R. 23 D L. $-22\ \mathrm{D} = \frac{5}{35}$.

SAME CASE AFTER OPERATION.

No.	Name.	Age.	Date.	Result.
1	A. H.	7	1903	L. without glass, $\frac{5}{7}$ R. − 19 D = $\frac{5}{15}$.
2	F. M.	30	1903	L. − 2.5 D and − 1.5 cyl. = $\frac{5}{15}$.
3	B. M.	8	1902	Without glass, $\frac{5}{10}$ L. − 18 D = $\frac{5}{20}$.
4	B. M.	25	1902	L. V. = 0 (detachment) R. − 20 D = $\frac{5}{60}$.
5	S. D.	21	1906	R. − $\frac{5}{20}$ without glass.
6	Dr. X.	28	1900	R. − 1.5 D = $\frac{5}{10}$.
7	W. K.	13	1897	R. + 1.5 D = $\frac{5}{15}$, 1900, $\frac{5}{25}$, 1903, $\frac{1}{50}$ hem.
8	A. T.	39	1897	L. − 2.5 D = $\frac{5}{10}$.
9	C. F.	11	1901	R. + 2.5 D = $\frac{5}{10}$.
10	M. D.	10	1900	L. + 2.5 D cyl. = $\frac{5}{10}$.
11	H. M.	22	1902	R. − 3.5 D = $\frac{5}{15}$.
12	C. G.	31	1900	R. + 2 D cyl. = $\frac{5}{10}$.
13	J. S.	36	1898	R. Without glass = $\frac{10}{20}$.
14	v. H.	15	1901	L. + 2 D = $\frac{5}{7}$.
15	C. H.	18	1901	L. − 1 D = $\frac{5}{10}$.
16	L. L.	14	1901	R. + 2 D cyl. = $\frac{5}{15}$.
17	M. R.	20	1901	R. − 1 D = $\frac{5}{7}$.
18	R. S.	26	1899	R. + 75 D = $\frac{5}{10}$.
19	G. S.	20	1900	Without glass, $\frac{5}{25}$ (L. − 15 D).
20	F. M.	7	1902	Without glass, R. = $\frac{5}{20}$.
21	R. S.	39	1901	L. = $\frac{5}{15}$ without glass.
22	H. P.	17	1900	L. + 5 D = $\frac{5}{20}$, later $\frac{5}{35}$ hem.
23	G. H.	12	1902	R. + 3 D = $\frac{5}{15}$.
24	A. D.	10	1903	R. + 2 D cyl. = $\frac{5}{25}$.

As one may see, the refraction of the aphakic eye coincides about as well with the figures of the table (page 92) as one can possibly expect, taking into consideration, after all said and done, the great difficulty of defining the degree of excessive myopia with absolute precision.

But I cannot leave this chapter on the operation for myopia, the most responsible one which I have to discuss, without advising you again to use the greatest care both in selecting the cases and in the operation. They are not operations for beginners, but for the practiced and experienced hand! They are not operations to be undertaken by one on a journey, but require to be undertaken in a properly fitted institution. I have seen a large number of patients

who have been operated on by others, both in Germany and abroad, who have consulted me on account of the unfavourable results. Many showed the bitterest regret that they had allowed themselves to be operated on. Educated people, such as students, that by the blinding of one of their eyes their happiness in life has been ruined. Some were almost entirely blinded, as was the case with a boy, aged sixteen, who, in February, 1894, was operated on the right eye for myopia. At the end of March, this eye was blinded by retinal detachment, while, in 1895, blindness came over the second eye by spontaneous detachment. Furthermore a person, aged twenty-two, came to me with detachment in the left eye, which could only count fingers at a foot, six years after detachment in the right one. Finally I saw a seventeen year old person, in 1898, who had been operated on both eyes for myopia three years before. In 1891 she had the nerve divided on account of the dreadful pain in her right eye which was blind through detachment, while the left eye, which was affected by considerable opacities and marked macula and peripheral pigmentary changes, could with + 4 D only count fingers at six feet, and showed considerable contraction of her field. This patient has continued to be unable to earn her living with a myopia of 12 D, which she may well have had before the operation. Had she been left alone she might, although one cannot say so with certainty, have passed through life much more happily.

I hope I have established the conviction among you that the operation for myopia is a two-edged sword, which should only be wielded in case of necessity, and that it is not right to extend the field of this operation too far.

So much for the cure of myopia. Now we come to its PRESERVATION. This, by its nature is more important. But what can we do? We cannot and will not break up our culture in order to return to a primitive condition of things in which there was no shortsight. On the other hand we cannot and dare not fold our hands as if this sacrifice was entirely unavoidable for our culture. For this purpose the visual substance is too costly. But we must make it clear what can well be accomplished and what again remains quite outside our influence.

A lady, twenty-three years of age, who hailed from abroad, once related to me, that a short time before, their oculist had made the bitterest reproaches to her parents who were both myopic, because they had married! But that came some twenty years too late. Perhaps the admonition of their doctor would have been without avail even at the right time.

His advice would have been practical if it had led to the delicate child being rightly brought up, the more so in such families in which high myopia is most common, especially where both the parents or the father or mother alone were highly myopic. For it is precisely at the time when the globe grows most actively that the hereditary tendency of the sclerotic should be preserved from deleterious influences.

Not everything that is modern is good, at least not from every point of view. *Froebel's* kindergarten school should be freed from the injurious outgrowth of early plaiting and needle work. One need only once see how such a mite of four years of age can occasionally make full use of its (as yet) unweakened accommodation in order to bring the needlework as near to its eyes, as if it wished to sew it to its

nose. Let the materials for play be abundant, and as far as possible, open-air games. The school must not begin too early; nor at the same time must its yoke press too heavily on the tender organ of vision.

But as soon as we put our foot inside the school—the pride of our age—we find ourselves immediately arrested by a fearful hubbub. "Now for *Cohn*, now for *Stilling*." The one expects everything to depend on the improvement of the school, the other hardly anything. The one believes that already the spread of myopia prevailed among the ancient Greeks, Romans, Arabians, as among ourselves. The other horrifies the world, or at least the faithful, by the Cassandra cry, that civilized races must perish from the increase of shortsight: a statement which direct observation has not upheld.

Let us examine these contending theories actually and impassionately. Let us first listen to those who are inclined to relieve us surgeons from the anxiety of school and education.

In his recent and clear essay on myopia, *Stilling* has given the following doctrine: Myopia was already well known both to the ancient Greeks as well as to the Romans and Arabians. Shortsight depends on reading and writing, and not entirely, or even mainly, through the unfavourable external conditions under which the work is performed. Shortsight, with a few exceptions of a purely pathological nature, arises only during the growth of the individual. At the termination of growth (about the twenty-fifth year) it tends to remain dormant; only in a small number of cases does it progress and reach the highest degree. The idea that myopia depends on an actual disease of the eye has been accepted for the last forty years and has been extended by

Donders. Clinically, one has to distinguish two forms of myopia.[1]

1. The common form, which remains quiescent after the completion of growth, and, 2, another form accompanied by extensive structural changes (occasionally even leading to blindness), which in many cases are not confined to the period of growth, but have already reached a high or even the highest grade during early childhood and in the majority of cases occur in such persons who have never applied themselves to strenuous near work, as *Guttmann* has shown by the statistics of *Magnus'* clinic. This last form arises through intermarriage and is a dropsy of the eye. The first form is no disease. Neither the accommodation nor the convergence hypothesis will account for the origin of the myopia of near work. The cause is the rotation outward, whereby the oblique muscles, especially the superior one, exert pressure on the growing eye.

Eyes with a myopia of 6–8 D and even 14 D have revealed nothing of a pathological nature, only a moderate axial lengthening up to 2 mm. The degree of myopia is of no account since the corneal curvature is so variable (7–9 mm. radius).

On the other hand an eye may show a relatively small degree of myopia and yet exhibit all the signs of grave disease, a dropsical extension, both by ophthalmoscopic investigation and by post-mortem sections. Then, when diseased eyes reach a very high grade of myopia, such as growth under the action of muscular pressure cannot produce, then such eyes before they can reach the high degree of shortsight

[1] Berlin, *Reuther* und *Reichard*, 1903, p. 75 (VI, 3 der Sammlung von Abhandlungen aus dem Gebiet der pædagogischen Psych. u. Physiol. v. Professor *Th. Ziegler* u. Professor *Th. Ziehen.*

must first pass through the lower grades. Transitions between the myopia of near work and the deleterious form do not exist.

The white half moon at the disc is the perspective appearance of the wall of the optic nerve canal which appears white. If the pulley of the superior oblique lies deep down, its tendon, when the muscle contracts, must press on the globe. The pulley is deeply placed, when the orbit is situated low down. A low built orbit (chamaikonche) has an index[1] of 80°, a median one (mesokonche) of 85°, and a high orbit (hyperkonche) of 88 or rarely 90°.

Adult measurements showed 80.5 for myopes, but 88.8 for normal eyes. Hence the disposition to myopia depends on the lower form of the orbit and this again depends on the breadth of face.

This doctrine was favourably received by pedagogues and opposed by the ophthalmic directors of school hygiene. *Schnabel* believed the myopic eye to be a healthy one although subject to a fault of development, which consists in an imperfect formation of the sclerotic around the optic nerve. But as in Europe, at least a third of all individuals are on an average disposed to myopia, one must conclude that nature, in every third case, was not, so to say, in a position to make the eye properly. Among long-faced races, shortsight is rare, among broad-faced races, common. Several scientists of repute see no disease in the myopia of near work, but a kind of natural adaptation. Thus argue *Tscherning, v. Hippel, Landolt* and *Schnabel;* even *Donders* changed his views on the subject. *Schnabel* considered myopia a positive advantage. Both *Goethe* and *Virchow* were shortsighted.

[1] Height to breadth = J : 100. For example, 32 : 49 = J : 100; J = 80. (See *Hess*, l. c., p. 297, Z. 6.)

Transition of the near work myopia into the deleterious form does not occur. The last can only be diminished by general hygiene, by the progress of intercourse and extended culture, which are gradually finding their way even into remote mountainous regions with a stagnating population. In Salzburg, there is one case of deleterious myopia to every thousand inhabitants. Good lighting, proper school-desks, clear print, and the like certainly contribute to diminish both the number of cases and the degree of shortsight; but that these are already far more than they ought to be, no one can deny, judging from our experience up till now.

The new palatial schools have not contributed much toward the diminution of shortsight. The demands of modern life have become so numerous, that one would do much more harm to the rising generation if one were to lower the standard of education, than if a part of it became shortsighted.

This published doctrine of *Stilling* is really very captivating. But several clinical facts militate against the supposition that it contains the whole truth.

1. Increased corneal curvature, or what amounts to the same thing, *the shortening of the corneal radius of curvature along the axis, is not the cause of the higher degrees of myopia in man.*

I have measured a large number of myopic corneæ (and naturally emmetropic and hypertropic ones as well) by means of *Javal's* ophthalmometer, and will briefly give you the results from the notes which my assistant, *Dr. W. Mühsam,* has collected from my private note-books.

In the years 1900, 1901, and the fourth quarter of 1899, 3,082 new patients were registered; among these, 391 cases (646 eyes) had shortsight of 6 D and over.

In the following table the radii of curvature as measured by me are given:

TABLE OF THE RADII OF CURVATURE OF THE CORNEA IN EYES OF 6 D AND OVER.

Corneal Radius in mm.	Number of Eyes Measured.		Total.
	Under Twenty Years.	Over Twenty Years.	
7.2		1 (7 D)	1
7.3		2 (8 D)	2
7.4	2 (6 D)	1 (16 D)	3
7.5	6	10	16
7.6	8	18	26
7.7	7	21	28
7.8	10	20	30
7.9	8	25	33
8.0	13	16	29
8.1	10	17	27
8.2	9	20	29
8.3	3	2	5
8.4	2	5	7
8.5	0	5	5
8.6	0	0	0
8.7	0	0	0
8.8	0	0	0
8.9		1	1
			242

That is to say, 242 eyes had myopia of 6 D and over, up to the highest grade.

In no single eye was the myopia due to excessive curvature of the cornea.[1] On the other hand the highly shortsighted eye has often a longer corneal radius than the emmetropic.

The mean value of the emmetropic eye (r = 7.7) was found in 28 high myopes, a rather shorter radius in 48, but a longer one than 7.7 in 166. *Donders* was perfectly right when he stated that according to his measurements of 34 myopic eyes

[1] Reduction of the radius of curvature by 0.1 mm. causes a diminution in the myopia amounting to about 0.5 D, so that we should expect a radius = 5.7 mm. for a corneal myopia of 10 D, and a radius = 6.7 for a corneal myopia of 6 D.

the myopic eye had, as a rule, a flatter cornea than the emmetropic one, and in the highest grades the flattest of all. As far as I know, no one has hitherto given the corneal radii of so large a number of myopic eyes.[1]

High myopia is caused by axial lengthening and not by increased curvature of the cornea.[2]

2. Certain as it is that the tendency to myopia is inherited, so it is venturesome, it seems to me even false, to declare that high myopia is a product of consanguinity. As regards the transmission of the myopic tendency we need no elaborate means to prove it. It is common knowledge. Were *Hippocrates* to write to-day, his celebrated sentence would have received an addition and could well have been written "Bald heads beget bald heads, blue eyes beget blue eyes, squints beget squints, and myopes produce myopes."[3]

Among 140 cases of high myopia (6 D and over) in my private practice, I find in my case-book a note to the effect that only 36 times did no myopia occur in the family, but that in 94 cases there was positive evidence that either the father or mother or both, or one of their brothers or sisters or parents or grandparents, or else several of the brothers and sisters of the patient suffered from a very high degree of shortsight.

Among 315 cases of high myopia (equal to or exceeding 6 D) in the Policlinic in which remarks on the subject are entered, we find 223 are positive and 82 negative.

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[1] Compare *Hess*, Refraction and Accommodation, p. 339.

[2] Moreover in cases of weak myopia (2 to 6 D) the radius is greater than in emmetropia. I found in the same 3,082 patients, 189 eyes with myopia of 2 to 6 D in which the radius was measured. R. = 7.7 in 12 eyes, less than that in 23 and greater in 154. In 45 cases the difference of the refraction was equal to greater than 3 D; *in* 36 *of these cases the radius was the same in both eyes*, or at the most only differed by 0.15 mm.

[3] From Water, Air and Places, chapter 14.

But it is not quite the thing to say that this deleterious myopia is a product of inbreeding. I have seen so many children with the highest myopia before they went to school, yet in whom no other signs of innate degeneration could be discovered. I have in mind a few examples of strikingly beautiful and well-educated children. I have only a very few observations to hand, in which I found early myopia among the children of such marriage relationships in whom signs of degeneration appeared in their brothers and sisters. Although the statistical investigation of the question relative to the relationship between consanguinity of the parents and degeneration in the children had not been settled up till that time,[1] I can still bring forward the fact that in 108 patients with high myopia, to whom the question was put, only 10 answered in the affirmative. *Wolff* found 8¾% among the deleterious form of myopia. *Velhagen* only 2% among the high degrees (10 D and over). Here a vast difference appears to exist in the material under observation.

As regards the number of consanguineous marriages I am indebted to my colleague, *Guttstadt*, for the following communication:[2]

The following was the proportion of consanguineous marriages to the total marriages in Prussia:

1900:	1,269	out of	293,064	marriages = 4.3	per 1,000
1901:	1,237	"	288,567	" = 4.3	"
1902:	1,327	"	281,532	" = 4.7	"

[1] *Oldendorff*, Eulenburg's Real Encycl., 3 Auf., III Bd., p. 634, 1894.

[2] It is astonishing that the article which I have just quoted on blood-relationship in *Eulenburg's* Real-Encycl. gives no statistics! In *Meyer's* Conversations Lexicon, 5 Aufl., Vol. III, p. 146, 1894, I find:

In Prussia, 1875–1883, 7.82 per 100. In Alsace-Lorraine, 1872–1875, 10.74 per 1,000. So in the field of observation of *Stilling* and *Laqueur*, who place a great value on affinity marriages, we find a markedly greater percentage than with us.

I do not deny the influence of consanguineous marriages. I do deny inbreeding in the sense that it affects the degeneration of the eye. How does it differ in this connection with regard to the pigmentary disease of the retina? How rarely does one find high myopia bound up with it?

3. I hold it to be entirely without proof that there are two entirely different kinds of myopia, a myopia caused by near study and a deleterious form, which never pass into each other.

That these deleterious cases are more common in country people than in the civilized towns I find just as little to be the case as do *Priestly-Smith, Widmark,* and *Proskauer.* The main result of my collective observations is as follows:

I. Ordinary myopia begins at school. It may already show a marked increase by the tenth or twelfth year. In the high school (gymnasia) pupils, whom I wish to quote as the most marked examples of persons whose eyes are highly strained by near work, the increase of myopia in the higher classes is now and then quite considerable. At the University on the other hand it increases more slowly, even by hard study. It appears to me very remarkable that in private practice the male sex somewhat preponderates on account of the literary callings of boys and youths; whereas in public (out-patient) practice the female sex takes the lead, owing to the hand work, which in the elementary schools is often carried on to a criminal degree (vielfach ein Unfug), for which I cannot find a milder and more parliamentary expression. In my private practice I found 391 patients with myopia of 6 D and over, viz., 204 males, 187 females, and besides these 67 patients with a shortsight of 2–6 D, comprising 43 males and 24 females.

The accompanying table from my out-patient practice shows the following results, as already mentioned:

6 D–10 D		11 D–20 D		21 D–35 D	
Males	140	Males	84	Males	10
Females	166	Females	149	Females	11

In most cases of myopia, after the body had ceased to grow, a fairly passive condition ensued. The diminution of myopia is only an apparent one; it depends on the fact that too high glasses are worn, and particularly that due regard has not been paid to the astigmatism.

Only occasionally (even in the fortieth and fiftieth years) will a further progress of the myopia be observed, and pass over into the diseased form.

II. There are cases of early myopia among those children on whom the injurious action of near work has not yet acted at all, or at any rate not perceptibly. This is rare.

III. There are cases of deleterious high myopia in some individuals who have never done any injurious near work. This likewise is rare.

IV. Deleterious high myopia is much more often seen in those adults who from their youth up have overstrained their eyes, or even misused them.

V. There are not two completely separated varieties—the *Near-work myopia* and the *Diseased form.* One sees in the same family every possible grade of shortsight, even in three consecutive generations—provided one has had time to study the question sufficiently—in fact, one can occasionally see some improvement, thanks to the increasing care and hygiene. If one has had opportunity to follow a case sufficiently long, i.e., for twenty to thirty years, one may ob-

serve in the same person the gradual progress and transition of the apparently simple myopia into the deleterious form.

My colleague, *Stilling*, implies that in such a case the deleterious form had, so to speak, been latent, but that is a fact we may very well presume, although we cannot prove it. For example, how shall we account for the extraordinary large number of our elementary school-teachers who have been afflicted with the worst and most dangerous form of myopia, by ascribing the cause of their troubles to intermarriage, when the frightful abuse of their delicate eyes is even recognized in the courts of law.

I therefore find myself incapable of agreeing with the ingenious views of *Stilling*. My temperament does not permit me to wait until the spreading culture reaches the isolated valleys with its stagnating population. Besides I would hardly know what use this would be to those thousands of unfortunates whom we have to treat for the injurious form of myopia!

The practical man feels himself compelled to place the lever where it can act—namely, at the school.

If the inherited formation of myopia has a great significance, yet the development of myopia for the most part ensues from the school influence.

I have observed myopia before the school age (pre-scholastic myopia) in a sufficiently large number of cases—not only among those classes in which myopia is altogether more frequent, but only as exceptions to the many thousands of children who become myopic in the school, and whose myopia always increases in proportion as the standard of the teaching progresses upward.

Among the 3,082 patients in my private practice who, as

already mentioned, consisted of 391 men (646 eyes) with high myopia (6 D and over) I found 6 cases which occurred before the school age. Among 12,320 patients in the public clinic 550 had high myopia (6 D and over), and 23 during the first ten years of life.

The school is imposed on us by law, and demanded by our will; it can only be replaced by the longer continued and less fatiguing private tuition. We must welcome it as a great advance that highly myopic children of the lower schools among us in Berlin can now enjoy the benefits of a sight preserving separate course of instruction.

H. Cohn, who published his meritorious investigations on the eyes of 10,000 school children, as far back as 1867, devoted a full discussion to the prevention of shortsight in his treatise on the "Hygiene of the Eyes, 1892," a work the study of which I would strongly recommend not merely to the school doctor[1] (that creation of recent times recommended by him), but also to every general practitioner. His very penetrating explanations can be made the foundation of the following statements which I shall at all events elucidate as based on my own experiences.

The old senseless school desks cause a bending down of the head so that the eyes are brought to a distance of 8 cm. or 10 cm. (3 or 4 inches) from the copybook—a most pernicious arrangement. The vertical distance between the surface of

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[1] His powers are indeed limited in the larger towns, although they are of more importance than in the ordinary town schools, especially in the high schools (gymnasia) and upper girl schools, where a much larger percentage of myopia will be met with than in the village schools. In Berlin the school physicians are zealous in their work. They do not require to be talked to by overzealous specialists because the eye and its diseases are not understood by them. Things which one is ignorant of, one should have to learn.

the table (or desk) and the form should be about one-seventh of the body height. There should be no horizontal distance between the slope of the chair or the form, and the table, or still better even 5 cm. (2 inches) overlapping, so that the front surface of the child who is sitting erect touches the edge of the table. The form must be the same height as the thigh, i.e., exactly two-sevenths of the height of the scholar. The desk should have a slope of 1.6; a ledge across is necessary. One is glad to find that the modern school-desks are coming more and more into requisition in our schools. But school children must sit straight upright at their home work. The family physician must also see after the school tables in the home, as far as the conditions will allow. Of course the tables must be altered to suit the growth of the children as well as shoes and clothes.

Since a falling off of the light considerably reduces the acuity of vision, the lighting of the school-rooms must be sufficient. The improved installations of the present day have made great strides in this respect, even in the dwellings of the poor. Upright writing is better suited to the upright position of the body than sloping letters.

The renunciation of Gothic [i.e., German and Danish.—*Translator.*] writing and types would probably afford relief to the children's eyes. [Hebrew is also bad for the eyes, owing to the close similarity of certain letters, but Chinese and Japanese characters are the most trying of all types, and especially for imperfectly corrected astigmatic eyes, in consequence of the faint horizontal lines contained in the characters. This may account for the fact that nearly all educated Japanese or Chinese wear glasses continually.—*Translator.*]

During the first years of school the children should not

be taxed too much. What is wanted is to lessen the amount of copy writing, to restrict or abolish the use of slates, to improve the blackboard, and for the teacher to draw on them in large and clear characters. Drawing and hand-work should be entirely given up during the first years of schooling, later on they may be adopted in a moderate degree.

School books[1] should not be printed in too small type, 1.5 mm. for the small n should be the smallest used, the down stroke must not be less than 0.25 mm., the interval between the letters not less than 2.5 mm., the length of the lines should not be more than 10 cm.,[2] and the number of letters in a line should not exceed 100.

The most important point is to avoid overstraining the eyes. Useless writing must be given up, and lastly one must restrict domestic work.

But here an important difficulty arises. Most, if not all, myopic children, devote the whole of their spare time to reading all sorts of useful as well as stupid books; and in fact every piece of printed matter which falls into their hands. The moment they take up a book it is immediately held close to the nose. (It is a habit which, when once it takes root, remains the whole lifetime, even in the case of educated men in important positions in life and in ripe old age.) In this case, severe measures must be taken by the teacher during school hours to prevent it, which he must persevere in maintaining.

In high degrees of myopia voluntary reading should only

[1] The eyes of adults equally need protection, although they can put up with more. For this reason I have not allowed the type of my Centralblatt f. Augenheilk. to be altered. During the whole of the thirty-three years of its existence, only one person has complained of it. I do not write for children.

[2] Javal suggested 9 mm. as the limit.—*Translator.*]

be permitted on days when there is not much work and then only for half an hour at a time. Also during school hours the eyes should be rested after half an hour's work, even if it is only for ten minutes. The children must be made to go out into the open air. Mental food, for which they thirst, must be chiefly administered orally.

Musical instruction should only be given to high myopes who have real inclination and talent for it, and then only in moderation. For those who have to make a living by it, it is especially necessary to be careful.

If, in spite of every precaution, the myopia of the child increases, and traces of macula changes show themselves, it is essential that school attendance or, at any rate, reading and writing should be postponed for at least a year, and if no changes for the worst have taken place, they may return to their tasks if precautions are taken.

No one, properly speaking, at any rate no school child, should wear spectacles unless prescribed by a doctor. *Förster*[1] is of opinion that increase in myopia depends chiefly on the convergence of the axis during near work and the resulting pressure of the external muscles on the globe. Further, he thinks that every myopic scholar whose shortsight exceeds 2.5 D should be fully corrected,[2] and the glasses worn continually, and only in high degrees of myopia should the writing distance be increased up to 12 inches, by corresponding concave glasses and abducting prisms applied. These opinions have been accepted with great enthusiasm and have been upheld by statistics.

[1] Arch. f. Augenh., 1885, p. 295. Centralbl. f. Aug., 1885, p. 463.

[2] Suppose a child has a myopia of 6 D and a reading distance of about 6″ = 15 cm., one should order − 3 D, whereby the myopia is reduced to a half, and the reading distance is removed to about 12″ = 30 cm. One can now add to the concave glass a prism of 3° with the base toward the nose.

The latest report is by *Seggel.*[1] The increase of myopia in 451 fully corrected scholars amounted on the average to 0.6 D for each person during a period within seven to nine years, but it amounted to 0.85 D in 1,619 persons who were not at all or only imperfectly corrected. Furthermore the myopia remained unchanged in 43% of those fully corrected, but only in 22% of those who were not at all or only incompletely corrected.

That is certainly a favourable result. In spite of that, the affair is by no means proved. Let us suppose one completes the statistics and returns again after twenty years, and one then follows up a hundred school children of 5 or 6 D of myopia for ten years, then one will learn that this rule, laid down with such great precision is not universal.

But there are observations undertaken for a long time which militate against it. *H. Cohn* stated that he got correction glasses of 1.75 D in the second form, and continually wore them and then within three years his myopia increased to 5 D. I also knew an educated man who was also myopic in the second form, and wore his spectacles too much in the higher grade school (gymnasium) until in the beginning of his student days his myopia had increased to 2.5 D ; from that time on he used concave glasses only for distance and performed a very large work at close distance without spectacles and had at sixty years of age a myopia of 3 D and full visual acuity.

The full and continual correction of school children is perhaps unnecessary, often impossible. It is useless when the myopia is less than 2 D. The eye reads ordinary print at the same distance as the emmetrope. Of what use are

[1] Arch. f. Oph., LVI, p. 551, 1903.

the spectacles? It is impossible for children to wear them continually when the myopia exceeds 6 D. Children who are compelled to wear spectacles of – 6 D, – 8 D, or – 10 D continually, are often made wretched from that moment, and would become healthier and happier as soon as they, or those in charge of them were either sensible enough to throw the spectacles away, or at least consult a wise and sympathizing surgeon who would take the injurious implement from them, and allow them to work either without glasses, or with a considerably weaker pair.

The only good feature about *Förster's* teaching is that when children whose myopia has obviously increased in a few years from about 0.5 D to 2.5 D, or from 1 D to 3 D, one should not only cut down the work considerably—but should give them such a pair of reading spectacles for their necessary and indispensable studies as will assure them a greater reading distance.

One may fully correct these cases of medium myopia, i.e., in boys; girls are with difficulty brought to wear glasses, even when one would make a concession to their good looks by prescribing pincenez in the place of hideous spectacles.

But for higher grades of myopia full correction is not generally accomplished—nay, not generally advisable. How often in the case of delicate children who have a myopia of 6 D wear – 4.5 D for work with difficulty, or cannot even bear them at all!

We should always test the nearsight of eyes furnished with concave glasses carefully and repeatedly, and watch the children, in order to be certain that we have not, by indulging in some theoretical and modern fad, done their eyesight real harm, through the prescription, instead of the hoped-for benefit. The surgeon will not succeed in com-

pletely allaying the social evil of myopia, even by the greatest attention and care, and by the most intelligent support on the part of the parents.

If shortsight has already made more rapid strides among our literary circles than well-wishers of our country would like to see, we have to remember that the noisy cry about increasing deterioration is not founded on fact, whereby the hope for a gradual improvement will not seem a vain one, thanks to the practical coöperation of so many intelligent men in the state, the school, and the medical faculty. The fundamental sense of the German people is solidly united, and new workers are forever making their way onward in order to carry out the necessary literary work, so that it is to be hoped that thanks to our ever-improving school buildings and better hygiene, together with more restricted demands on the normal province of vision, the onward progress of myopia may yet be arrested.

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